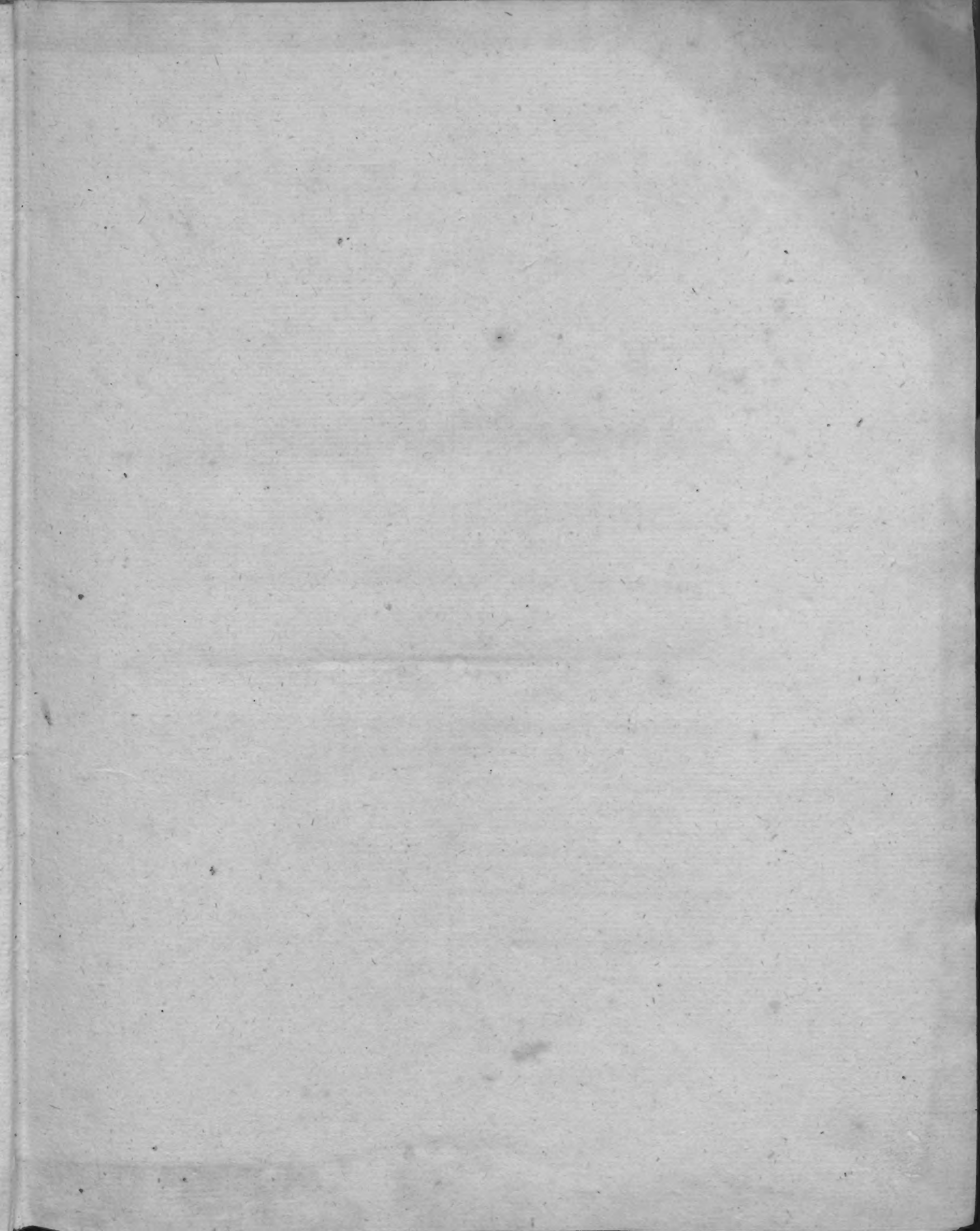


Accademia di Scienze







Very scarce & curious

A N
ORIGINAL THEORY
O R
NEW HYPOTHESIS
O F T H E
U N I V E R S E,

Founded upon the
L A W S of N A T U R E,
AND SOLVING BY
MATHEMATICAL PRINCIPLES
T H E

General PHÆNOMENA of the VISIBLE CREATION;
AND PARTICULARLY

The V I A L A C T E A.

Compris'd in Nine Familiar LETTERS from the AUTHOR to his FRIEND,
And Illustrated with upwards of Thirty Graven and Mezzotinto Plates,
By the Best MASTERS.

By **THOMAS WRIGHT**, of DURHAM.

*One Sun by Day, by Night ten Thousand shine,
And light us deep into the DEITY.*

Dr. YOUNG.

L O N D O N:
Printed for the AUTHOR, and sold by H. CHAPELLE, in Grosvenor-Street.

MDCCCL.



AN
ORIGINAL THEORY
OF
NEW HYPOTHESES
OF THE
UNIVERSE

FOUNDED UPON THE
LAWS OF NATURE
AND SOLVING THE
MATHEMATICAL PRINCIPLES
THE

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And light as day into the Day.
Dr. Young.

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THE
P R E F A C E.



THE Author of the following Letters having been flattered into a Belief, that they may probably prove of some Use, or at least Amusement to the World, he has ventured to give them, at the Request of his Friends, to the Publick. His chief Design will be found an Attempt towards solving the Phænomena of the *Via Lactea*, and in consequence of that Solution, the framing of a regular and rational Theory of the known Universe, before unattempted by any. But he is very sensible how difficult a Task it is to advance any new Doctrine with Success, those who have hitherto attempted to propagate astronomical Discoveries in all Ages, have been but ill rewarded for their Labours, tho' finally they have proved of the greatest Benefit and Advantage to Mankind. This ungrateful Lesson we learn from the Fate of those ingenious Men, who, in ignorant Times, have unjustly suffered for their superior Knowledge and Discoveries; they who first conceived the Earth a Ball, were treated only with Contempt for their idle and ridiculous Supposition, as it was called; and he who first attempted to explain the *Antipodes*, lost his Life by it; but in this Age Philosophers have nothing to fear of this sort, the great Disadvantages attending Authors now, are of a widely different

Nature, rising from the infinite Number of Pretenders to Knowledge in this Science, and much is to be apprehended from improper Judges, tho' from real ones nothing; for nothing is more certain than this, as much as any Subject exceeds the common Capacity of Readers, so much will the Work in general be condemned; the Air of Knowledge is at least in finding Fault, and this vain Pretence generally leads People, who have no real Foundation for their Judgment to argue from, to ridicule what they are too sensible they do not understand. Thus the same Disadvantages too often attend both in publick and private an exceeding good Production equally the same as a very bad one: But the Author is not vain enough to think this Work without Faults, has rather Reason to fear, from the Weakness of his own Capacity, that there may be many; but he hopes the Design of the Whole will, in some measure, plead for the Imperfection of the Parts, if the Merits of the Plan should be found insufficient for his full Pardon, in attempting so extensive a Subject.

In a System thus naturally tending to propagate the Principles of Virtue, and vindicate the Laws of Providence, we may indeed say too little, but cannot surely say too much; and to make any further Apology for a Work of such Nature, where the Glory of the Divine Being of course must be the principal Object in View, would be too like rendering Virtue accountable to Vice for any Author to expect to benefit by such Excuse. The Motive which induces us to the Attempt of any Performance, where no good Reason can be supposed to be given for the Omission, or Neglect of it, will always be judged an unnecessary Promulgation, and consequently every Attempt towards the Discovery of Truth, the Enlargement of our Minds, and the Improvement of our Understandings will naturally become a Duty. If therefore this Undertaking falls short of being instrumental towards the advancing the Adoration of the Divine Being in his infinite Creation of higher Works, and proves unable to answer all Objections that may possibly arise against it, yet will its Imperfections appear of such a Nature to every candid Reader, as to afford the Author a sufficient Apology for producing them to the World: And it is to be hoped farther, that where a Work is entirely upon a new Plan, and the Beginning, as it were, of a new Science, before unattempted in any Language, the Author having dug all his Ideas from the Mines of Nature, is surely intitled to every kind of Indulgence.

To

To those who are weak enough to think that such Enquiries as these are over-curious, vain, and presumptive, and would willingly, suitable to their own Ignorance and Comprehension, set Bounds to other People's Labours, I answer with Mr. *Huygens*, " That if our Forefathers had
 " been at this Rate scrupulous, we might have been ignorant still of the
 " Magnitude and Figure of the Earth ; or that there was such a Place as
 " *America*. We should not have known that the Moon is enlightened by
 " the Sun's Rays, nor what the Causes of the Eclipses of each of them
 " are ; nor a Multitude of other Things brought to Light by the late
 " Discoveries in Astronomy ; for what can a Man imagine more abstruse,
 " or less likely to be known, than what is now as clear as the Sun."

Had we still paid that Homage to a Name,
 Which only God and Nature justly claim ;
 The western Seas had been our utmost Bound,
 Where Poets still might dream the Sun was drown'd ;
 And all the Stars that shine in Southern Skies,
 Had been admir'd by none but savage Eyes.

DRYDEN.

Besides the Nobleness and Pleasure of these Studies, *Wisdom* and *Morality* are naturally advanced, and much benefited by them, and even Religion itself receives a double Lustre, " to the Confusion of those who
 " would have the Earth, and all Things formed by the shuffling Concourse
 " of Atoms, or to be without Beginning." In Astronomy, as well as in natural Philosophy, though we cannot positively affirm every thing we say to be Facts and Truth, yet in so noble and sublime a Study as that of *Nature*, it is glorious, as Mr. *Huygens* says, even to arrive at Probability.

Notwithstanding then the Disadvantages which ever have attended all new Discoveries, either thro' the Ignorance of the Age, or the universal Passion of Ridicule in such contented Creatures, as can't comprehend, yet ever attacking with a fool-hardy Resolution, the advancing Ensigns of Knowledge, if Ignorance was Virtue, and Wisdom Vice ; I say, regardless of this noisy Shore, it is sure our Duty to spring forward, and explore the secret Depths of Infinity, and the wonderful hidden Truths of this vast Ocean of Beings. But how the heavenly Bodies were made, when they were
 made

made, and what they are made of, and many other Things relating to their Entity, Nature, and Utility, seems in our present State not to be within the Reach of human Philosophy; but then that they do exist, have final Causes, and were ordained for some wise End, is evident beyond a Doubt, and in this Light most worthy of our Contemplation.

He who thro' vast Immensity can pierce,
See Worlds on Worlds compose one Universe,
Observe how System into System runs,
What other Planets, and what other Suns;
What varied Being peoples ev'ry Star;
May tell why Heav'n made all Things as they are.

P O P E.

To expect that so new an Hypothesis should meet with universal Approbation, would be an unpardonable Vanity; nor is it reasonable every Reader should think the Author obliged to remove all his Prejudices and Partialities, so far as to give him the perfect Picture of the Universe he likes best. In many Cases it would be so far from being better for the World, if all Men judged and thought alike, that Providence seems rather to have guarded against it as an Evil, than any how to have promoted it as a general Good: But the following Theory regards the Whole rather than Individuals: And the many worthy Authors cited in the Work, who have all greatly favoured this extensive Way of Thinking, will, I hope, be a sufficient Excuse for forming these obvious Conjectures into a Theory, especially where so great a Problem is attempted as the Solution of the *Via Lactea* Phenomenon, which has hitherto been looked upon as an insurmountable Difficulty. How the Author has succeeded in this Point, is a Question of no great Consequence; he has certainly done his best; another, no Doubt, will do better, and a third perhaps, by some more rational Hypothesis, may perfect this Theory, and reduce the Whole to infallible Demonstration: The first System of the solar Planets was far from a true one, but it led the Way to Perfection, and the last we can never too much admire. It is well known, that the first System of the Planets was also but a Conjecture, yet none will deny that it was an happy one.

The

The Discovery of the Magnet Poles; the Government of the Tides; proportional Distance and Periods of the Planets, &c. have all their Uses, and undoubtedly were designed to be known. Ignorance is the Disgrace of Mankind, and sinks human Nature almost to that of Reptiles. Knowledge is its Glory and the distinguishing Characteristic of rational Creatures.

To Enquiries of this sort, then sure we may say with *Milton*, That

GOD'S OWN EAR LISTENS DELIGHTED.

The Subject is, no Doubt, the noblest in Nature, and as such, will always merit the Attention of the thinking Part of Mankind. Men of Learning and Science, in all Ages, have ever made it their peculiar Study. Towards the latter End of the Republic, and afterwards in the more peaceable Times of *Trajan* and the *Plinys*, we have no Reason to doubt but that Astronomy was in the highest Reputation: And notwithstanding *Greece* had been the chief Seat of the Philosophers, yet may we suppose *Rome* in those Days little inferior in the Knowledge of the Stars, when we find Men * of the first Figure in Life become Authors upon the Subject.

We have many Instances to shew, that Astronomy was in the greatest Repute amongst the Antients of all Ranks, and almost every where looked upon as one of the greatest, if not as one of the first Qualifications of their best Men. As a Confirmation of which, we find in the historical Accounts of the *Argives*, a very warm Contest betwixt the two Sons of *Pelops* 1205 Years before *Christ*, thus testified by *Lucian*: When the *Argives*, by publick Consent, had decreed that the Kingdom should fall to him of the two, who should manifest himself the most learned in the Knowledge of the Stars, *Thyestes* thereupon is said to have made known to them, the Constellation, or Sign of the *Zodiack* call'd *Aries*: But *Atræus* at the same time discovering to them the Course of the Sun, with his various Rising and Setting, demonstrating his Motion to be * contrary to that of the Heavens, or diurnal Motion of the Stars, was thereupon elected King.

* *Cicero* translated the *Phænomena* of *Aratus* into Latin Verse. *Julius Caesar*, as *Pliny* relates, wrote of Astronomy in *Greek*, and is said to have left several Books of the Motion of the Stars behind him, derived from the Doctrine of the *Egyptians*. *Ant. Chris.* 45. He with *Sosigenes* reformed the *Roman Year*, which was first invented by *Numa Pompilius*. *Germanicus Cæsar* also translated *Aratus's Phænomena* into Latin Verse *Anno Dom.* 15. *Tiberius* and *Hadrian* are also said to have wrote on Astronomy.

* Hence arose the Fable of the Sun's going backwards in the Days of *Atræus*, as if struck with Abhorrence of his bloody Banquet. *Vide Ovid's Metamorphosis.*

To

To recite more of the most eminent Patrons and Professors of this kind of Learning here, will carry me too far from my present Purpose; for farther Information therefore, I shall refer the inquisitive Reader, to that curious Catalogue in *Sherburn's Sphere of Manilius*, where so many ruling † Men of all Ages and Nations swell, and illustrate the Number.

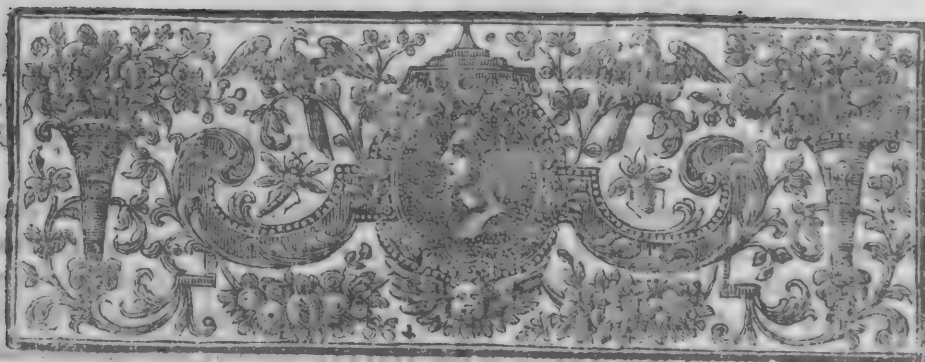
In a Word, when we look upon the Universe as a vast Infinity of Worlds, acted upon by an eternal Agent, and crouded full of Beings, all tending through their various States to a final Perfection, and reflect upon the many illustrious Personages, who have, from time to time, thought it a kind of Duty to become Observers, and consequently Admirers of this stupendious Sphere of primary Bodies, and diligent Enquirers into the general Laws and Principles of Nature, who can avoid being filled with a kind of enthusiastic Ambition, to be acknowledged one of the Number, who, as it were, by thus adding his Atom to the Whole, humbly endeavours to contribute towards the due Adoration of its great and divine Author.

I judge it will be quite unnecessary to say any thing about the Order of the Work, since that would be only a Repetition of the Table of Contents, to which the Reader is referred, as to the properest Account that can here be given.

† Seven Emperors, nine Kings, and as many sovereign Princes. *Charlemagne* wrote *Ephemerides*, and named the Months and Winds in *High Dutch*, 770. *Rich. H. &c.*



T H E



LETTER THE FIRST.

Opinions of the most eminent Authors whose Sentiments on the following Subject have been published in their Works.

S I R,



REFLECTING upon the agreeable Conversation of our last Meeting, which you may remember chiefly turned upon the Stars, and the Nature of the planetary Bodies; a Subject, which is generally allowed to give true Pleasure to all those who take Delight in mathematical Enquiries; and having not a little Regard to the repeated Request in your late Letters, I have at length undertaken to explain to you, as far as I am able, my Theory of the Universe, and the Ideas I have form'd of the known Creation.

The Hypothesis upon which this new Astronomy is founded, and now reduced into a regular System, was the result of my Astronomical Studies * full fifteen years ago, hence I hope you will allow, I have more than observed *Horace's* celebrated Aphorism,

Nonumque prematur in annum.

* The first Scheme of this Hypothesis was plann'd in the Year 1734, representing in a Section of the Creation, eighteen Feet long and one broad, several thousand Worlds and Systems, and a great Number of emblematical Figures, now in the Author's Possession, together with a Scheme of the entire Creation, completed since, nine Feet long and six broad, more fully illustrating upon the same Construction the Innumerability of Systems and Worlds.

B

The

LETTER THE FIRST.

The Subject, I have often observed, you have listened to with a pleased Attention, and I am the more encouraged to explain it at large to you, as I am perswaded you don't want to be convinced of its valuable Uses and Importance.

I remember you have often told me, that to apply ourselves to the Study of Nature, was the surest and readiest Way to come at any tolerable Knowledge of ourselves, however difficult the Task might prove either in the Attempt, or the attaining it, and the less to be neglected, as it never fails to introduce a proper Knowledge of the DIVINE BEING, as a certain Consequence along with it, and such a Knowledge, as will naturally make every Man, who has but a tolerable Share of common Sense, and is not a Slave to another's Reason, without any other Evidence or Motive, in all Stations, and under all Circumstances, ACT JUSTLY, LIVE CHEARFULLY, and DIE full of Hope in the Expectation of a happy Sequel, in Futurity.

*Eternity is written in the Skies:
Mankind's Eternity, nor Faith alone;
Virtue grows there ———*

Dr. YOUNG.

A learned Author on the Attributes, recommending these Studies as a reasonable and moral Service, says, " Sure, it is most becoming such imperfect Creatures as we are, to contemplate the Works of God with this Design, that we may discern the Manifestations of Wisdom in them; and thereby excite in ourselves those devout Affections, and that superlative Respect, which is the very Essence of Praise."

*Who turns his Eye, on Nature's Midnight Face,
But must enquire ——— what Hand behind the Scene,
What ARM ALMIGHTY, put these wheeling Globes
In Motion, and wound up the vast Machine?*

The enchanting Idea *Milton* had of the Subjects of Astronomy (whose truly sublime Way of thinking and writing perhaps was never so nearly equalled, or attempted before this Reverend Author's *Night-Thoughts*, appear'd is finely shewn in the Eighth Book of his *Paradise Lost*, where he makes his *Adam*, so earnestly attentive to the Angel *Gabriel*, as to cease relating the Mysteries of Creation.

The

LETTER THE FIRST.

3

The Angel ended, and his *Adam's* Ear
So charming left his Voice, that he awhile
Thought him still speaking; still stood fix'd to hear.

Milton's own Ideas of the Universe too, which no doubt he had gathered from astronomical Authors, and had reconciled himself to, we are fully made acquainted with in the same Book, where the Arch-angel says, in answer to *Adam's* Enquiries.

— Other Suns perhaps
With their attendant Moons thou wilt descry
Communicating Male and Female Light,
Which two great Sexes animate the World,
Stor'd in each Orb, perhaps with some that live:
For such vast Room in Nature, unpossess'd
By living Soul, desert and desolate,
Only to shine, yet scarce to contribute
Each Orb a Glimpse of Light, convey'd so far
Down to this habitable, which returns
Light back to them, is obvious to Dispute.

But before I presume to plan my own Discoveries and Conjectures into a Theory, both in Justice to those who have in some measure been in the same Way of Thinking, and also as a Defence of myself for producing so new an Hypothesis to the World, which otherwise (though any Apology made to you I know will be unnecessary) may appear to too many but an idle *Chimera* of my own. I judge it will be highly proper, by way of strengthening my own Arguments, and adding more Weight to what I shall myself advance in the following Letters, to give you in this the Opinions of the most able Writers, whose Works I have read upon the Subject. I mean so far as relates to the now general received Notion, that the Stars are all Suns, and surrounded with planetary Bodies, with which I shall set out; and shew you, it is not a Thing merely taken for granted, but has ever been the concurrent Notion of the Learned of all Nations, as shall be further shewn, in its proper Place, and as nearly as Possibility will admit of, demonstrated to be Truth.

The following is an Extract from Mr. *Toland*, in his Account of the Works of

JORDANUS BRUNO.

“ The Divine Efficacy (says this Author in his infinite Creation) cannot
“ stand idle, without the Want of Will or Power; but any Imbecillity in
B 2 “ such

“ such a Being argues Imperfection, and since any finite Produce compared with Infinity is as nothing, or rather as the Beginning of Good, it must be no less idle, and invidious in producing a finite Effect, than in producing none at all.

“ Hence, as all Finites, singly considered, are but as Commencements of something more to be expected.

“ Omnipotence, in making the Creation finite, will appear to be no less blameable for not being willing, than for not being able, to make it otherwise; *i. e.* infinite, as being an infinite Agent upon a finite Subject, which is repugnant to Reason.”

It follows then that, Creation must be not only extensively, but intensively indefinite, and beyond the Reach of the human Understanding to comprehend; and that the one is as necessary as the other, *i. e.* an infinite Expanse is as reconcileable to our Reason, as infinite Parts are to our Senses.

All the Attributes of the Divine Being are, as any one of them, incompatible to his Creatures; why should our Imagination then be supposed to extend beyond the divine Activity?

“ Thus, adds the above Author, the Excellency of God is adequately magnified, and the Grandeur of his Empire made manifest; he is not glorified in one, but in numberless Suns; not in one Earth, or in one World, but in ten thousand thousand of infinite Globes.”

An infinite Representation of an infinite Original, and a Spectacle befitting the Excellency and Eminence of him, that can neither be fully conceived, imagined, or comprehended.

What read we here? th'Existence of a God?

Yes, and of other Beings, Man above,

Natives of Æther! Sons of higher Climes!

Dr. YOUNG

“ If the Existence of this one World be good or convenient, it is not less good or convenient that there be infinite others like it.

“ The infinite efficient Cause would be absolutely defective, without an infinite Effect; and besides, by conceiving the Infinity of the Universe and innumerable Beings, the Understanding rests satisfied, and is reconciled with the Idea of an Eternity; whereas, by asserting the contrary, it is unavoidably plunged into innumerable Difficulties, and unsolvable Inconveniencies, Paradoxes, and Absurdities.

Again, says the same Writer, “ Did we but consider and comprehend all this, oh! to what much further Considerations and Comprehensions

“ should

LETTER THE FIRST

"Should we be carried! as we might be sure to obtain that Happiness
by virtue of this Science, which in other Sciences is sought after in vain.

This Prospect vast, what is it? weigh'd aright,
'Tis Nature's System of Divinity,
And every Student of the Night inspires.

Dr. YOUNG.

'Tis elder Scripture, writ by God's own Hand;
Scripture authentic! uncorrupt by Man.

"This then is that Philosophy, which opens the Senses, which satisfies
the Mind, which enlarges the Understanding, and which leads Man
kind to the only true Beatitude, whereof they are capable according to
their natural State and Constitution; for it frees us from the solicitous
Pursuit of Pleasure, and from the anxious Apprehensions of Pain, mak-
ing us to enjoy the good Things of the present Hour, and not to fear
more, than we hope from the future; since that same Providence, or
Fate, or Fortune, which causes the Vicissitudes of our particular Being,
will not let us know more of the one, than we are ignorant of the
other."

And farther, "From these Contemplations, if we do but rightly consider,
it will follow, that we ought never to be dispirited by any strange Ac-
cidents, through Excess of Fear or Pain, nor ever be elated by any pros-
perous Event, through Excess of Hope or Pleasure; whence we have
the Path to true Morality, and following it, we shall of course become
the magnanimous Despisers of what Men of weak Minds fondly
Esteem, and be wise Judges of the History of Nature, which would be
written in our Minds, and consequently be chearful and strict Execu-
tioners of the divine Laws, which would thus be engraved in the Cen-
ter of our Hearts. Seeking, as it were, in ourselves, an Approbation of
our own Action, which alone is capable of true Content and Happi-
ness."

CHRISTOPHER HUYGENS;

To whom the World is much indebted for many curious Inventions, and
Discoveries, says in his *Planetary Worlds*, "I must be of the same
Opinion with all the great Philosophers of our Age, that the
Sun is of the same Nature with the fix'd Stars; and this will give us a
greater

† The Pendulum Clock; the first Discovery of Jupiter's Satellites, and Saturn's Ring.

“ greater Idea of the World than all other Opinions can. For then
 “ why may not every one of these Stars, or Suns, have as great a Retinue,
 “ as our Sun, of Planets, with their Moons to wait upon them? Nay,
 “ there is a manifest Reason why they should ; for, if we imagine our-
 “ selves placed at an equal Distance from the Sun and fix’d Stars, we
 “ should then perceive no Difference at all betwixt them.

“ Why then may we not make use of the same Judgment that we
 “ would in that Case ; and conclude, that our Star has no better Atten-
 “ dance than the others ? So that what we allowed the Planets upon the
 “ Account of our enjoying it, we must likewise grant to all those Planets
 “ that surround that prodigious Number of Suns. They must have their
 “ Plants and Animals, nay, their rational Creatures too, and those as great
 “ Admirers and as diligent Observers of the Heavens as ourselves ; and
 “ must consequently enjoy whatever is subservient to, and requisite for
 “ such Knowledge.

“ What a wonderful and amazing Scheme have we here of the mag-
 “ nificent Vastness of the Universe ! So many Suns, so many Earths, and
 “ every one of them stock’d with so many Herbs, Trees, and Animals,
 “ and adorned with so many Seas and Mountains ! And how must our
 “ Wonder and Admiration be increased, when we consider the prodig-
 “ ious Distance and Multitude of the Stars ?”

The Opinion of Sir ISAAC NEWTON.

This great Author, in his grand *Scholia* to the *Principia*, says : --- “ The
 “ most beautiful System of the Sun, Planets, and Comets, could only pro-
 “ ceed from the Counsel and Dominion of an intelligent and powerful
 “ Being : And if the fix’d Stars are the Centers of other like Systems, these,
 “ being form’d by the like wise Counsel, must be all subject to the Do-
 “ minion of One ; especially, since the Light of the fix’d Stars is of the
 “ same Nature with the Light of the Sun, and from every System Light
 “ passes into all the other Systems. And lest the Systems of the fix’d
 “ Stars should by their Gravity fall mutually on each other, he (the Di-
 “ vine Being) hath placed those Systems at immense Distances from one
 “ another.”

The

The Opinion of Dr. DERHAM, in his Astro-Theology.

“ The new System, says he, supposeth there are many other Systems of Suns and Planets, besides that, in which we have our Residence ; namely, that every fix’d Star is a Sun, and encompassed with a System of Planets, both primary and secondary, as well as ours. “ These several Systems of the fixed Stars, as they are at a great and sufficient Distance from the Sun and us ; so they are imagined to be at as due, and regular Distances from one another : By which means it is that those Multitudes of fixed Stars appear to us of different Magnitudes, the nearest to us large ; those farther and farther, less and less ; and that some, if not all of those vast Globes of the Universe, have a Motion, is manifest to our Sight, and may easily be concluded of all, from the constant Similitude and Consent that the Works of Nature have with one another.”

To this we may add, that this System of the Universe, as it is physically demonstrable, is far the most rational and probable of any. *Because,*

“ It is far the most magnificent of any, and worthy of an infinite CREATOR, whose *Power* and *Wisdom*, as they are without Bounds and Measure, so may they, in all Probability, exert themselves in the Creation of many Systems as well as one. And as Myriads of Systems are more for the *Glory* of God, and more demonstrate his *Attributes* than one ; so it is no less probable than possible, there may be many besides this which we have the Privilege of living in.” And as the strongest Confirmation of this, “ we see it is really so, as far as it is possible it can be discerned by us, at such immense Distances as those Systems of the fixed Stars are from us ; and we cannot reasonably expect more.”

“ Since the Sun and fix’d Stars, says Dr. Gregory, are the only great Bodies of the Universe that have any native Light, they are justly esteemed by Philosophers to be of the same Kind, and designed for the same Uses ; and it is the Effect of a Man’s Temper that sets a greater Value upon his own Things than he ought, that makes him judge the Sun to be the biggest of them all.”

That, as an elegant * Writer observes, which we call the Morning, or the Evening Star, is, in reality, a *Planetary World* ; which, with the four others, that so wonderfully, as *Milton* expresses it, “ vary their mystick Dance, are in themselves dark Bodies, and shine only by Reflection ; have Fields and Seas, and Skies of their own ; are furnished with all Accommodations for animal Subsistence, and are supposed to be the

Abodes

* Contemplations on the starry Heavens.

“ Abodes of intellectual Life. Again, The Sun, with all its attendant Planets
 “ is but a very little Part of the grand Machine of the Universe. Every
 “ Star— is really a vast Globe, like the Sun, in Size and in Glory, no less
 “ spacious, no less luminous, than the radiant Source of our Day; so that
 “ every Star is the Center of a magnificent System, has a Retinue of
 “ Worlds irradiated by its Beams, and revolves round its active Influence;
 “ all which are lost to our Sight in immeasurable Tracts of Æther.
 “ Could we, says the same Author, wing our Way to the highest ap-
 “ parent Star — we should there see other Skies expanded, other Suns,
 “ that distribute their inexhaustible Beams of Day; other Stars, that gild
 “ the alternate Night; and other perhaps nobler Systems established;
 “ established in unknown Profusion, through the boundless Dimensions
 “ of Space. Nor does the Dominion of the great Sovereign end *there*,
 “ even at the End of this vast Tour, we should find ourselves advanced
 “ no farther than the Frontiers of Creation; arrived only at the Suburbs
 “ of the great *Jehovah's* Kingdom.”

O for a Telescope his Throne to reach!
 Tell me ye Learn'd on Earth! or Blest above!
 Ye searching, ye *Newtonian* Angels! tell, *CREATOR*
 Where your great Masters Orb? His Planets where?
 Those conscious Satellites, those Morning Stars,
 First-born of *Deity* from central Love.

Dr. YOUNG.

Many other Authorities might be produced from Writers of great Re-
 pute, were it necessary to trouble you with them †; but I believe those
 above will be abundantly sufficient for the present Purpose, if even an
 Apology were wanting for my own Conjectures. I shall therefore con-
 clude this Letter with the following Passage out of *Pope's universal Prayer*,
 and in my next shall proceed in the Work I have undertaken.

Yet not to Earth's contracted Span,
 Thy Goodness let me bound;
 Or think thee Lord alone of Man,
 When thousand Worlds are round
 I am, &c.

LETTER

† Particularly from *Ponténelle*, &c.

LETTER THE SECOND.

Concerning the Nature of Mathematical Certainty, and the various Degrees of Moral Probability proper for Conjecture.

S I R,

YOU know how much I am an Enemy to the taking of any thing for granted, merely because a Person of reputed Judgment, has been heard to say, *it absolutely is so*; an *Ipse dixit*, and implicit Faith in some Cases, may be both necessary and useful; but here, in Astronomy, I mean, every Man's Reason, by the Help of a very little Mathematicks, is able to bring wonderful Truths to Light without them; and Truths not only of the highest Importance to every Individual, but of a great and common Consequence to all Mankind: And as such, in all Ages of the World, have been judged worthy to be enquired into, by the best and wisest of Philosophers.

You are likewise very sensible how far the human Understanding is even at the best, from being infallible, and don't want to be told, how difficult it is in a Subject of this Nature to arrive at any tolerable Degree of Certainty, which before the Days of the sagacious *Euclid*, and the penetrating *Archimedes*, was a Thing not to be expected. And many things which were then but barely Objects of Conjecture and Probability, have since been demonstrated to be infallibly true. Time and Observation will undoubtedly, at last, discover every thing to us necessary to our Natures, and proper for us to know. As a Proof of which, we see human Wisdom daily increases; and while a Capacity continues to make ourselves still more acquainted with the manifest Wisdom and Power of God in the Works of his Creation, who is to tell us where to stop our Enquiries? Or who is so impious to set Bounds to a Science, which so evidently spreads through all Infinity, the Attributes of God, and an eternal Basis for future Hope?

This Branch, or rather Body of Astronomy, I believe you will find to be quite new; and though evident Truths, are the principal Thing to be regarded in it, yet as being in its infant State, where lineal Demon-

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stration

stration fails, as in some Cases it cannot be otherwise, I hope you will give me Leave to make use of a weaker Way of Reasoning, to convince you of the Point in Dispute, I mean of that by the Analogy of known and natural Things.

I shall be extremely unwilling to affirm any thing for a *Fact*, or Truth, without bearing, if not the real Evidence, at least a plausible Reason, next to a Conviction, or moral Certainty, along with it; and therefore I will here endeavour to explain to you what I mean by moral Certainty and also by mathematical Proof.

Mathematical Proof, or Certainty, proper for Conjectures, may, to almost every Capacity, be illustrated as follows:

Suppose you had accidentally found a very small Part of a visibly broken Medallion, with nothing more express upon it, than what is represented at *Fig. 1. Plate I.* a Person totally unacquainted with the mathematical Sciences, we may naturally conclude, would not be able to make any thing of it, or in the least comprehend what it originally was, or meant; but if an Astronomer should chance to see it, who of course we are to suppose knew the Order and Proportion of the planetary Orbits, he would immediately conclude, and with great Probability, on the Side of his Conjectures, that it might be Part of a Medal representing the Solar System. In such a Case may we not very naturally suppose he would reason thus?

The Arches A and B seem to be Portions of the respective Orbits of *Saturn* and *Jupiter*, and what may lead us to believe, that they are really so, and Part of the Solar System, is the oblique Curve C, which looks not unlike the Trajectory of a Comet.

This surely would be far from an irrational Conjecture, and consequently in some Degree probable: But this is not sufficient you'll say; To prove it we must have farther recourse to the Mathematicks, and a Mathematician would immediately thus demonstrate it to be true.

First, by completing the Circles geometrically from the fourth Book of *Euclid*, by the Assistance of any three Points E. F. G. the original Figure will be restored, as at *Fig. 2.* And secondly, by assuming any two Points, as F, E in the Curve C, if admitted a Parabola, by a well-known Problem in Conic Sections the Heliocentric Portion X. Y. Z. will easily be projected and shewn, as in *Fig. 3.* Lastly, join this in Position to the former, and it will justly supply the Orbit, or Path of some one of the Comets; and if required, even what Comet may be discovered by comparing the Perihelion Distance Y. S. with their general Elements or Theories, in Dr. *Hally's Synopsis* of the Motion of these Bodies. And if a farther Confirmation of the Truth of these Conjectures were wanting,

the

PLATE.I.

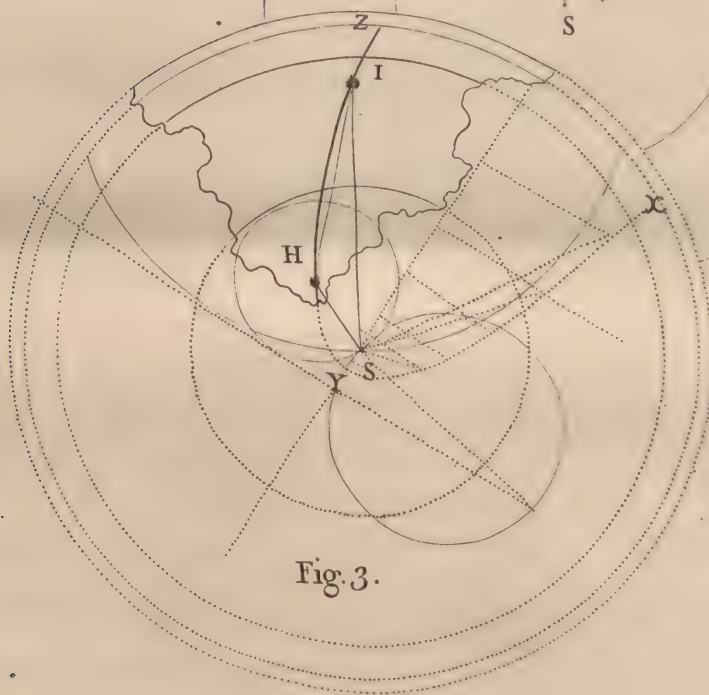
Fig. 1.



Fig. 2



Fig. 3.



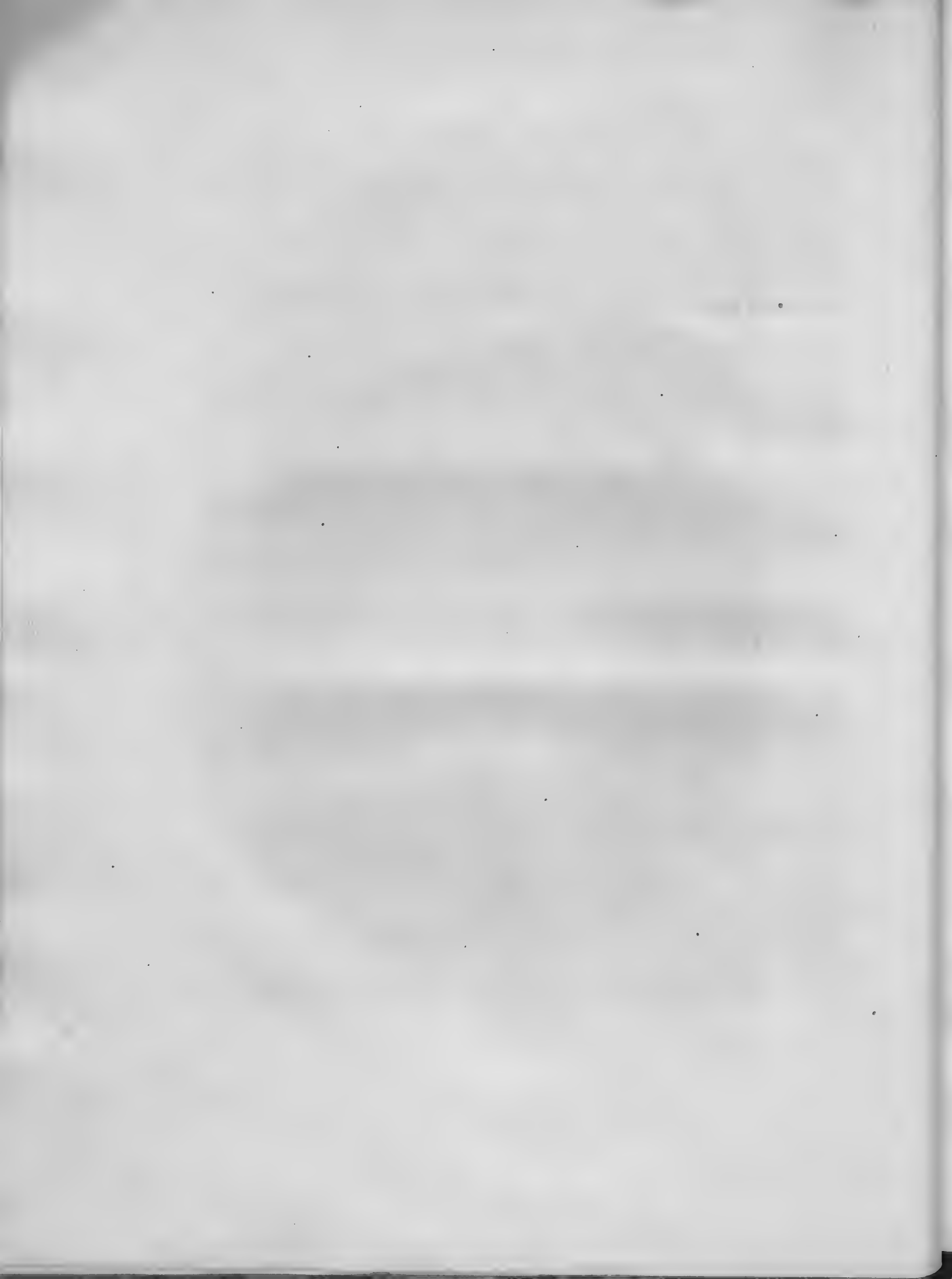
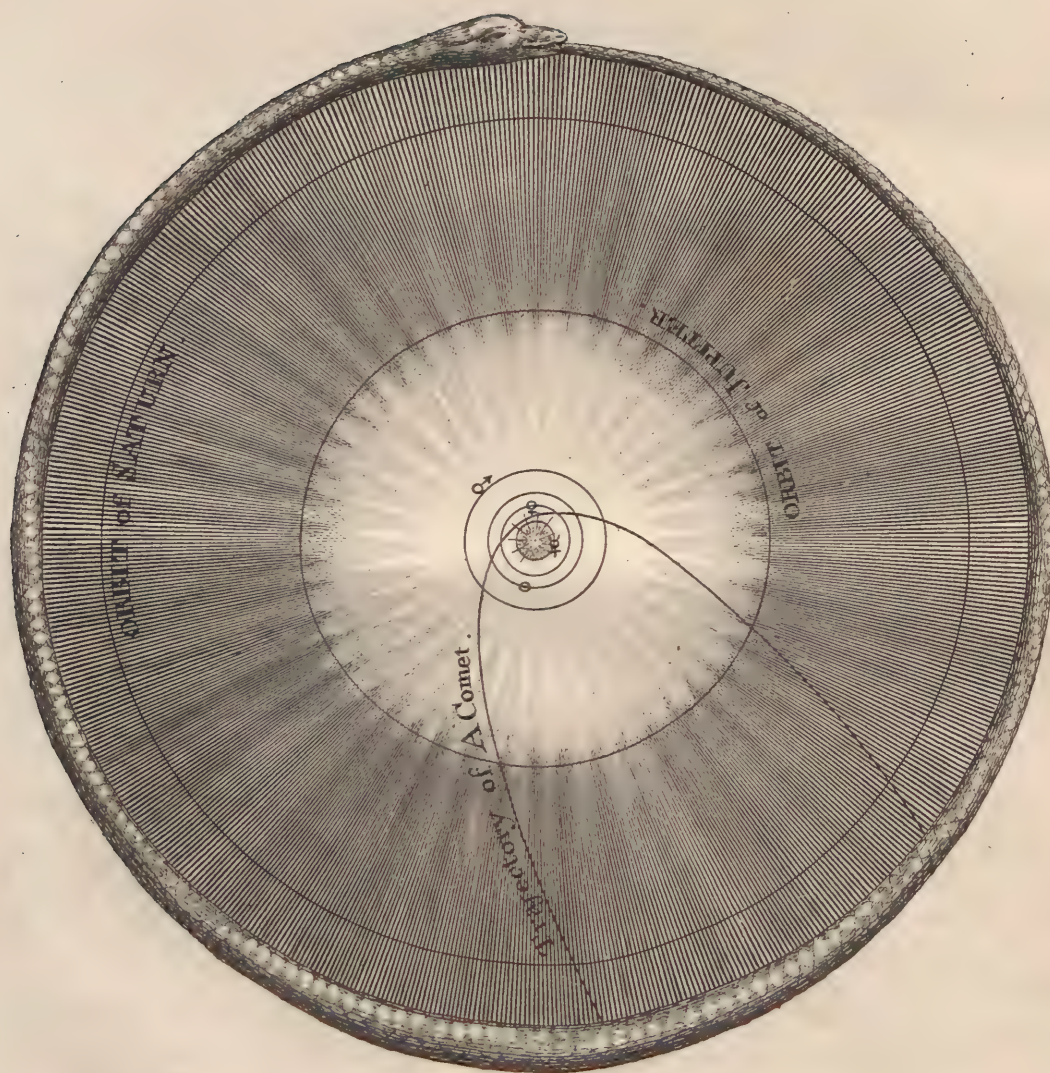


PLATE II.



the small concentric Circles at D would now be allowed beyond a Contradiction, to represent the secondary Orbits of *Saturn*; and thus the first Presumption being carried thro' several corroborating Degrees of Probability, almost past a Dispute, would become a mathematical Certainty; and the above imperfect Piece of Medallion, would evidently appear beyond a Contradiction to be Part of a Representation of the said solar System, and such as is shewn in *Plate II. Q. E. D.* Thus in many Cases, it often happens, that from a very small Part of *orbicular Things*, we are able to determine the Form and Direction of the Whole: And hence you may conceive it no very difficult Task to a Mathematician, to describe the Orbits of all the Planets in the solar System, though he had never observed them but in one and the same Sign of the *Zodiack*; thus far I have thought it would not be amiss to explain to you the Nature of those Steps, by which we arrive at moral Certainty, and where the Subject will admit of it, Mathematical Conviction, which will not a little contribute to strengthen many of the Arguments hereafter made use of, and in some Degree serve to supply the Place of Proof, where infallible Demonstration cannot from the Nature of the Thing be discovered.

But besides the indisputable Principles of Geometry, the universal Law of Analogy and Similitude of things, have a Privilege to assist us, in Conjectures relating to the heavenly Bodies, and though not of equal Force with the former, is often as conclusive as the Subject requires. This sort of probable Evidence (as *Dr. Butler* observes,) is essentially distinguished from "Demonstrative by this, that it admits of Degrees; and "of all Variety of them, from the highest moral Certainty to the very "lowest Presumption; and that which chiefly constitutes Probability, is "expressed in the Word *Likely*, or Natural Likeness, as to State or Being." This general Way of arguing, I think, is allowed to be evidently natural, just and conclusive, and unquestionably to have its Weight in various Degrees, towards determining our Judgment: For Instance, should any ignorant Person, endowed with rational Principles, cut open a *Pomegranate* of the natural Growth of *England*, and finding it full of small Globules, or Kernels, upon being presented with an every way similar Fruit, said to be the Produce of *Italy*, doubt of its being of the same Nature, and composed of like globular Seeds within; here indeed would be no mathematical Evidence to assist the Judgment, the Object of Proof being invisible, but sure from the external Similitude, the strongest Probability of their being also internally the same. Again,

Is it natural to suppose, that the first Person who found a *Lark's* Nest, and in it several of the Female's Eggs, should have any Apprehensions of finding none in the *Nightingale's*, only because he had never seen one be-

fore, I believe the most illiterate Person of the earliest Ages, who had Curiosity enough for such a Search, would be greatly disappointed in such a Case, and far from concluding that the *Nightingale* had none. Farther, should any one who had seen several Sorts of Fish taken out of the River *Thames*, or out of the *Nyle*, have any sort of Suspicion that he should find no such Creatures in the *Seine* or the *Ganges*, though it should be allowed that he had never seen any such Creatures that were known to come from thence. Ocular Demonstration, in such a Case, would sure be unnecessary, and an Evidence of the first, I believe would be abundantly sufficient to convince us of what we ought to look for at least in the last: But then the Fishes of different Seas, and of Rivers are not of the same Species you'll say; but as it were infinitely diversified through all the aqueous World, this is, and must be granted, and alike Variety of *Species* must also be granted, in the former Case of the Birds: But no Objection can possibly arise from any such Diversity, since we don't pretend to say, nor is it at all necessary, that the Beings in the sidereal Planets should be every where the same with these of our solar System, a Variety must every where be admitted, and will always be admired, where the Work is Nature's, and the Design God's.

All then that I here pretend to argue for, is a Universality of rational Creatures to people Infinity, or rather such Parts of the Creation, as from the Analogy and Nature of Things, we judge to be habitable Seats for Beings, not unlike the mortal human.

Every Animal, and every Vegetable, that, as it were, naturally exists by the Virtues, Properties, or Laws of the mineral Kingdom, has something of a secondary Nature, depending upon it as a Principle; and to say that the Stars, which are a certain visible sort of Contemporaries in Space with the Sun, have no like planetary Bodies with ours moving round them, because we cannot possibly see them, is no less absurd and ridiculous, than to argue, that we can have no Reason to expect to find, in the proper Season, Grapes upon every Vine — Figs upon every Tree — Roses upon every Bush — only because some of them are at such a Distance, that neither Rose, Fig or Grape, can be discovered by the Eye.

This sort of Reasoning, though some perhaps may neglect it, I am persuaded you will look upon as abundantly sufficient for Things out of the Reach of Science to determine; and that the collective Body of Stars have not been discovered, to be together a proper Subject for such Conjectures before, can surely only proceed from the Want of Time, necessary to compleat the Observations proper for a Foundation to build such an Hypothesis, or Theory upon. This is the great Article in which the Moderns have so much, and ever will have, an Advantage over the Antients. And hence it will appear, That

The

The Improvements and Discoveries of latter Ages are not at all owing to the greater Capacity of the Moderns, but from the Advantages received, or arising from the Inventions and Progress made by the Ancients. We at first in a manner walked by their Leading-strings, and though many of them now are broke, or useless, none can deny, but that formerly they were of great Advantage in promoting and directing philosophical Enquiries.

In an Assembly of the most eminent Men of all Ages, if we may suppose such a Conference amongst the illustrious Dead, on Purpose to deliver their several Sentiments familiarly together, on the most interesting Subjects of natural Knowledge, who would not lament the Disadvantages, poor old *Thales*, an *Hipparchus*, or a *Ptolomy*, would lie under, who had nothing but the Eye of Reason to direct them, in Opposition to the Judgment of a *Brake*, or a *Galileus*, who reaped so much Benefit from their compound Opticks? But on the other hand, perhaps if the solar System, was the Topic of Discourse, a * *Pythagorean* might very pertinently say to a *Newtonian*, "You have not gone much farther in the Light with our Direction, than we did in the Dark alone; for you are still roving round the same Circles." Much might be said upon this Head; but I believe it would be a difficult Matter to do Justice to all Parties: So here I intend to leave them, only must observe, that Posterity will always have the Advantage over their Predecessors; and that After-ages, in all Probability, will reap so great a Benefit from the Invention and Improvement of Fluxions, that scarce any thing, which is the immediate Object of such Enquiry, will long lie concealed from a true mathematical Genius.

For this, in which he has surpassed all the Antients, and greatly advanced the philosophical Sciences, the World is indebted to Sir *Isaac Newton*.

But as many of his Discoveries, such as relate particularly to the Laws of the planetary System, are but as so many Confirmations of the Conjectures and Imaginations of Astronomers and Philosophers before him, it perhaps will not be amiss to acquaint you a little with the Astronomy of the Antients concerning the Universe. And before I proceed to those of my own, shew you in the first Place how far their Speculations in the visible Creation have been carried; and with these I shall conclude this preparatory Epistle.

The Universe, or mundane Space, by which the Antients comprehend all Creation, has, from time to time, according to the Progress of Science, come under a sort of Necessity of being variously modell'd agreeable to the
Opinion

* The true System of the Planets have been discovered above two thousand Years.

Opinion of the several Authors, who have judged themselves wise enough to write upon it with a mathematical Foundation: And the cosmical System, by which is meant the Co-ordination of its constituent Parts has undergone almost as many Changes as its Elements are even capable of; every Age of the World, as Knowledge has increased, either from improved Imagination, or repeated Observations, producing something new concerning it.

MILTON, no doubt, had all this Diversity of Opinions in View, as appears from his supposed Pre-knowledge of *Raphael*, in the following Passage, *Book. VIII.*

Hereafter, when they come to model Heaven,
And calculate the Stars, how they will weild
The mighty Frame! how build, unbuild, contrive
To save Appearances, how gird the Sphere
With centric and eccentric scribbl'd o'er;
Cycle, and Epicycle, Orb in Orb.

But the following Synopsis, I believe, will abundantly convince you that from certain Observations only, we ought to form all our Notions of it, if we either hope to arrive at Truth, or expect our Ideas should be supported by Reason.

ARISTOTLE was of Opinion, that the Universe, or Heaven, was all one World, and St. CHRYSOSTOM, TERTULLIAN, St. BONAVENTURE, TYCHO BRAHE, LONGOMONTANUS, KEPLER, BULIALDUS and TELLEZ, were of an united Opinion, that this one Heaven, or Universe, was all fidereal and fluid. But AEGIDIUS, HURTADUS, CISALPINUS, and AVERSA, believing the same Heaven with them to be all one World, and that fidereal, yet on the contrary held it to be solid.

CLEMENS, ACACIUS, THEODORET, ANASTASIUS, SYNAITA, PROCOPIUS, SUIDUS, S. BRUNO, and CLAUDIANUS MAMERTUS, supposed the universal mundane Space as divided into two Heavens, namely,

The Empyræum created the first Day,
And the Firmament created the second Day.

Two Heavens were also held by JUSTIN MARTYR, the one fidereal, and the other aerial. The first supposed by St. GREGORY NYSSENE, to be that of the fixed Stars, and the last, that of the Planets. But *Masfrus* and *Bellutus*, though agreeing in the Number of Heavens, call one the *Primum Mobile*, and the other, the Starry Heaven.

Farther,

LETTER THE SECOND.

15

Farther, St. BASIL, St. AMBROSE, DAMASCENE, CASSIODORUS, GENEBRARDUS, SUAREZ, TANNERUS, HURTADUS, OVIEDUS, TELLEZ, and BORRUS, distinguished the Universe as divided into three Portions, or Heavens.

The first called the Empyræum,	Or, as Cajetan.	Watery,	The Aquinas.	
The second supposed Sidereal,		Sidereal,		Watery,
And the last of all, Aerial.		Aerial,		Sidereal.

Again, St. *Athanasius* adds to those of the fix'd Stars, the Planets, and the Air, that of the *Empyræum*, and makes in all four Heavens.

But as the Number of the Heavens thus increases, and will become subdivided in the subsequent Account of them, to give you a better Idea of the Order of these celestial Portions of the mundane Space, it will not be amiss to form what remains of them into regular Sections of their proper Spheres and Systems.

See *Plate III.* in which Figure, the first represents a Section of the cosmical Theory of *Oviedus* and *Ricciolus*: Both consisting of five Heavens, viz.

By <i>Oviedus</i> , fidereal and solid.	The fixed Stars,	A	By <i>Ricciolus</i> , sider. and fluid.	<i>Empyræum</i> ,	G
	<i>Saturn</i> , - - - - -	B		The Water,	F
	<i>Jupiter</i> , - - - - -	C		The fixed Stars,	A
	<i>Sol</i> , with σ , φ and η included	D		The Planets,	H
	The Moon. - - - - -	E		The Air.	I

Fig. II. represents that of venerable *Bede* and *Rabanus*, viz. of Seven Heavens.

And according to <i>Bede</i> composed of		But by <i>Rabanus</i> ,	
The Air, - - - - -	P	The Atmosphere,	
The Æther - - - - -	O	The upper Air,	
<i>Olympus</i> , - - - - -	N	The inferior Fire,	
The Element of Fire, - - -	M	The superior Fire,	
The Firmament, - - - - -	A	Sphere of the fixed Stars,	
The Angelical Region, - - -	L	The Chrystalline Heaven,	
Realm of the Trinity. - - -	K	The <i>Empyræum</i> .	

Fig.

Fig. III. Represents the Hypotheses of *Eudoxus*, *Plato*, *Calippus*, *Cicero*, *Riccius*, *Philo*, *Remigius*, *Aben-Ezra*, *Carthusianus*, *Lyranus*, *Tostatus*, *Brugensis*, *Orontius*, *Cremoninus*, *Philalethæus*, *Amicus*, and *Ruvius*; also the *Babylonians* and *Egyptians*.

Consisting of Eight Heavens,

All Sidereal, viz. The Sphere of the fix'd Stars, and those of the Seven Planets.

Fig. IV. is that of *Macrobius*, *Haly Alpetragius*, *Rabbi-Josue*, *Rabbi Moyse*, *Scotus*, *Abraham Zagutus*, *Sacroboscus*, *Claromontius*, *Avigra*, and *Arriaga*.

All of Nine Heavens,

Comprehend a *Primum Mobile* Q, or, according to *Arriaga*, a solid *Empyræum*. The Sphere, of fixed Stars A, and the seven Regions of the solar Planets.

Fig. V. is that of the great *Alphonfus*, *Fernelius*, *Regiomontanus*, *Amicus*, *Maurolycus* and *Langius*; also of *Azabel*, *Thebit*, and *Isaac Israelita*; and likewise of *Gulielmus Parisiensis*, and *Johannes Antonius Delphinus*.

Consisting of Ten Heavens, made up of

A <i>Primum Mobile</i>	— — —	S <i>Empyræum</i> .
A Sphere of <i>Tripidation</i> in Longitude	—	R <i>Primum Mobile</i> .
The Sphere of the fixed Stars	— —	A
And those of the seven solar Planets within.		

Note, Some Authors place the Sphere of *Tripidation* in Longitude below that of the *Aplain*, or Eighth Sphere.

Lastly, Fig. VI. is the Heaven of *Petrus Alliacensis*, the College of *Conimbra*, *Martinensis*, (and sometime) of *Clavius*; and also *Johannes Warnerus*, *Leopoldus de Austria*, *Johannes Antonius Maginus*; and lastly, of *Clavius*.

In all Eleven Heavens containing,

T	A <i>Primum Mobile</i> , or, as others say, an <i>Empyræum</i> .
V	A Sphere of Libration in Latitude.
W	A Sphere of Libration in Longitude.
A	The Sphere of the fixed Stars, and those of the Planets.

Thus you see how many various Opinions have from time to time been imbraced concerning the Fabric and Formation of the visible Universe; all of which are now and have long been exploded; and although at first advanced by Men of the greatest Learning, and of the deepest Penetration in natural Knowledge, it does not appear from any one of their Opinions, that they had any the least Notion of infinite Space, but as it

were

PLATE III.

Fig. I.





LETTER THE SECOND.

17

were confined the Divine BEING to their limited Notions, as one may say in an Egg-shell. If therefore what I shall hereafter advance, extend so far without the known Creation, that you can possibly conceive no Bounds to the Works of infinite Wisdom and Power, I hope you will be in no Danger of looking upon it as more ridiculous, or absurd, than what so many of the wisest Men of every Age have thought proper to attempt, and have judged worthy of their Attention so long before me. If any thing less so, I shall think myself happy enough in having broke, or rather passed the narrow Limits to which the Creation has for so many Years been confined, in hopes of tempting Men of greater Talents to look upwards, and pursue so noble a Subject as far as the human Understanding is capable of comprehending it.

To the Opinions above might be added many more, particularly that of *Johannes Baptista Turrianus*, and *Fracastorius*, who increased the Number of Heavens to fourteen, viz. seven on each Side the *Aplané*.

But of this I have said enough; in my next I shall proceed to Matter better grounded,

And am, &c.



D

LETTER

LETTER THE THIRD.

*Concerning the Nature, Magnitude, and Motion of the Planetary Bodies
round the Sun, &c.*

S I R,

THE younger *Pliny*, if I remember right, somewhere says, that there is, or ought to be, a wide Difference betwixt writing to a Friend, and writing to the Publick : I have indeed pleased myself with the one, but am far from thinking myself qualified for the other ; I must therefore rather intreat you, though perhaps you cannot possibly overlook all my Faults as an Author, to excuse them at least in the Friend, and by such kind of unlimited Indulgence, you will give me a much greater Chance to do the Subject some Justice, though I own I despair in this first Attempt, to reconcile every thing I advance to your more cool and impartial Reasoning. But to the Business :

As I have no Ambition to have the Substance of my Theory more admired by you than understood, which is too often the Case in Works of this Nature, I must beg leave to repeat to you Part of a former Discourse, which will refresh in your Ideas the principal Laws of the System of our Sun, and make you properly acquainted with such Things as are necessary to be known in the now-established Astronomy of * *Copernicus*, &c. before I proceed to any new Matter.

The

* *NICOLAUS COPERNICUS*, filed by *Bulialdus*, *Vir absolutæ subtilitatis*, was a Native of *Thorn* in *Pelish Prussia*, and Canon of the Church of *Frawenburgh* ; he was Scholar to *Dominicus Maria* of *Ferrara*, to whom he was Assistant in his astronomical Observations at *Bologna*, and Professor of the Mathematicks at *Rome*, in his noble Work, *De Revolutionibus Orbium Cælestium* ; he fortunately revived, happily united, and formed into an Hypothesis of his own, the several Opinions of *Philolaus*, *Heraclides Ponticus*, and *Ecphantus Pythagoreus*, viz. after the Opinion of *Philolaus* he made the Earth to move about the Sun, as the Center of its annual Motion ; and according to *Heraclides* and *Ecphantus*, he likewise gave it a diurnal Rotation round its own Axis : Which System has withstood all Opposition ; and as *Ricciolus*, (though a Dissenter from it) observes, *Per damna, per cædes, ab ipso sumit opes, animumque ferro.*

LETTER THE THIRD.

19

The Sun, you are not to learn, is the reputed Center of our *Planetary System*, and may remember, that the Earth on which we live, and these five following *Erratic Stars*, viz. SATURN, JUPITER, MARS, VENUS and MERCURY, have been demonstrated to move round him in the Order and Manner following.

Saturn is found to complete one Revolution round the Sun in twenty-nine Years, one hundred and seventy-four Days, six Hours, and thirty-six Minutes; at the Distance of about seven hundred and seventy-seven Million of Miles. *Jupiter* performs a like Revolution in about eleven Years, three hundred and seventeen Days, twelve Hours, and twenty Minutes; distant from the Sun about four hundred and twenty-four Millions of Miles. *Mars* compleats his Circuit in one Year, three hundred and twenty-one Days, twenty-three Hours, and twenty-seven Minutes; and his mean Distance is about one hundred and twenty-three Millions of Miles.

These three are called superior Planets, as being farther from the Sun than the Earth, and circumscribing its Orbit.

The Earth circumambiates her Orbit in one solar Year, viz. in three hundred and sixty-five Days, five Hours, forty-eight Minutes, and fifty-seven Seconds; at the mean Distance of eighty-one Million of Miles.

The Radius of *Venus's* Orbit is about fifty-nine Millions of Miles; and that of *Mercury* nearly thirty-two Millions, *ditto*.

The Heliocentric Revolution of *Venus*, is made in two hundred and twenty-four Days, sixteen Hours, forty-nine Minutes, and twenty-seven Seconds; and that of *Mercury*, in eighty-seven Days, twenty-three Hours, fifteen Minutes, and fifty-four Seconds. These two last Planets are called inferior Ones, as being circumscribed by the Earth.

The Diameter of the Sun being demonstrated to be nearly seven hundred and sixty-three thousand Miles:

The proportional Magnitudes of all the above Planets will be found nearly as follows, viz.

The Diameter of the Globe,			} Miles.
Of <i>Mercury</i>	- -	4,240	
<i>Venus</i>	- -	7,900	
the Earth	- -	7,970	
<i>Mars</i>	- -	4,440	
<i>Jupiter</i>	- -	81,000	
and <i>Saturn</i>	- -	61,000	

D 2

Thus

Thus much I have thought proper to premise, and for your immediate Inspection, have added the following Schemes, that nothing may be wanting to give a general Idea of the Order of the celestial Bodies in our own System, before I attempt to lead you through the neighbouring Regions of the Stars to the more remote Tracts of Infinity.

P L A T E . IV.

Is a true Delineation of the solar System, with the Trajectories of three of the principal Comets, whose Periods and Orbits have been accurately determined, and are represented in their true Proportion and Position to one another, and the Order of the Planets round the Sun, marked with their respective Characters, viz. ♄, for *Saturn*, ♃, *Jupiter*, ♂, *Mars*, ⊕, the *Earth*, ♀, *Venus*, and ☿, *Mercury*. The Scale being nearly five hundred and eighteen Millions of Miles to an Inch.

P L A T E . V.

Is a true Projection of the System of the known Comets; in which are represented nine of the chief Trajectories, from their *Aphelii* to their *Perihelii*, all in just Proportion and Position to the Orbits of *Saturn* and *Jupiter*, which are also represented by the two concentric Circles, supposed to be drawn round the Sun as their Center.

The Ellipsis, or Trajectory, marked A, shews the Position and Path of the Comet which appeared in the Year 1684, whose Period is supposed to be about fifty Years, and has been observed within the Region of the Planets once.

That mark'd B, is the Way of the Comet of 1682;

The Period conjectured to be about seventy-five Years and a half, and has been observed thrice.

C, Way of the Comet of 1337;

The Period about 100 Years, observed once.

D, That of the Comet of 1661;

The Period about 129 Years, observed twice.

E, Tract of the Comet of 1618;

The Period about 160 Years, observed once.

F, Way of the Comet of 1677;

The Period about 200 Years, observed once.

G, Way of the Comet of 1744;

The Period about 300 Years, observed once.

H, Way of the Comet of 1665;

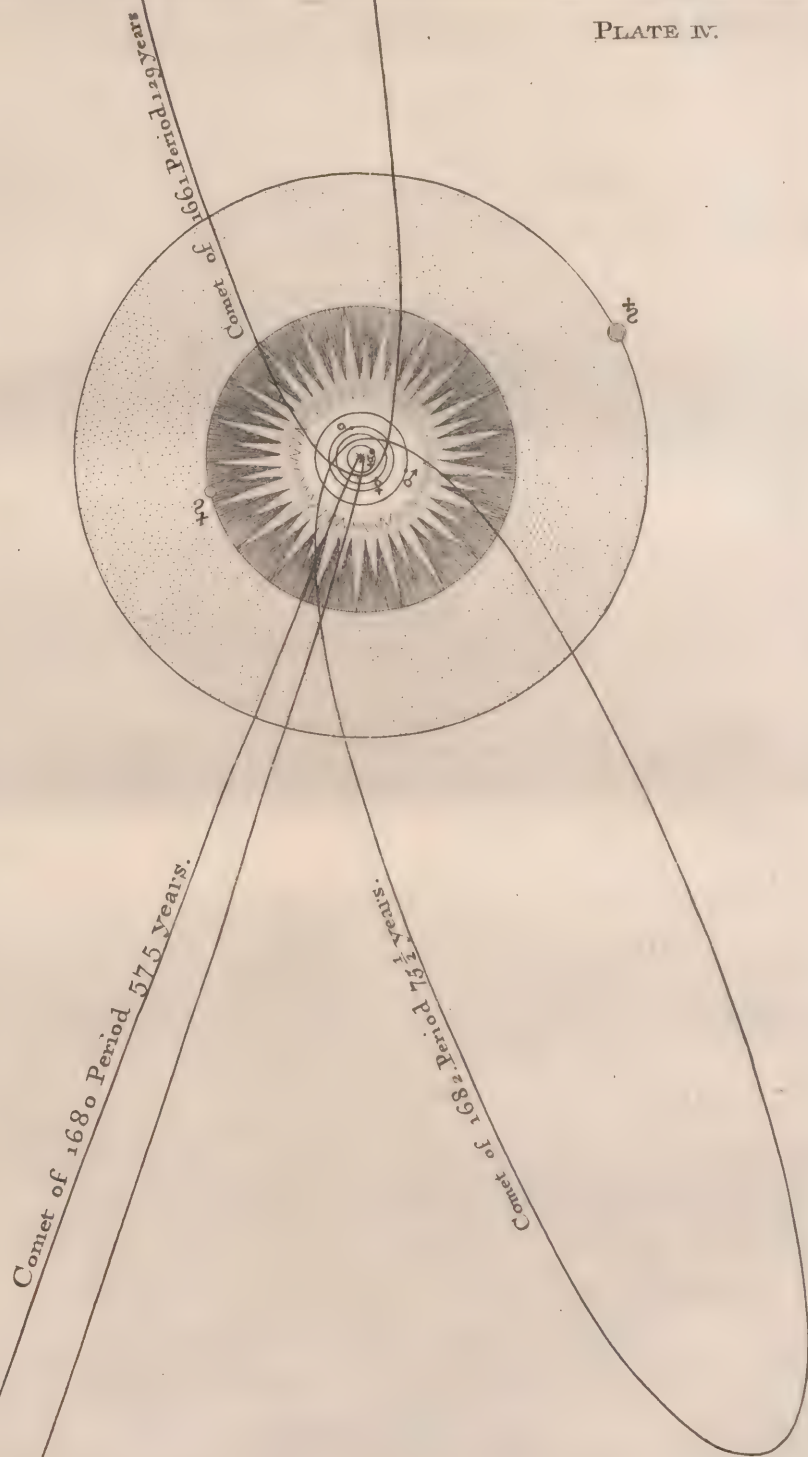
The Period about 400 Years, observed once.

I, Way of the Comet of 1680;

The Period about 575 Years, observed thrice.

The

PLATE IV.



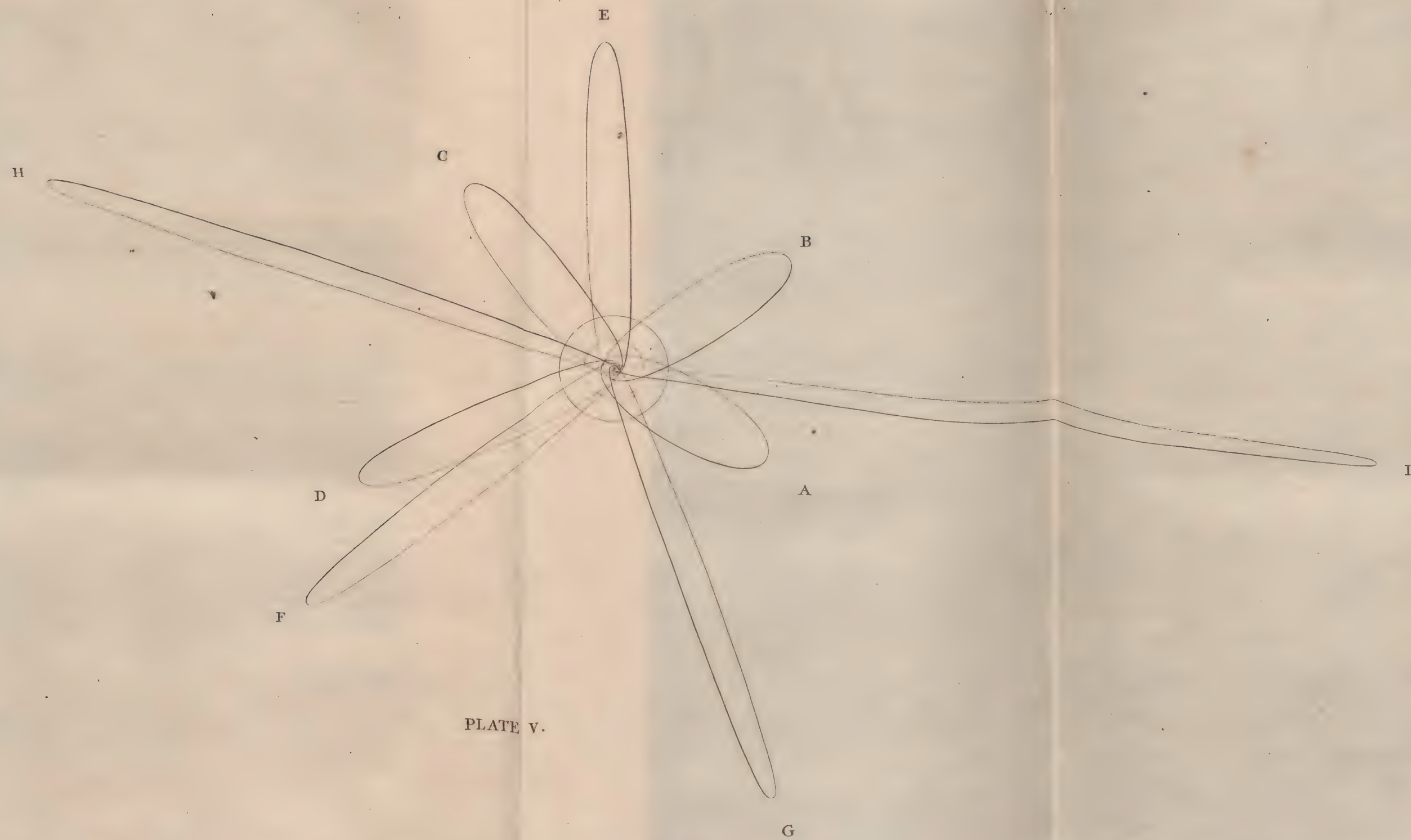
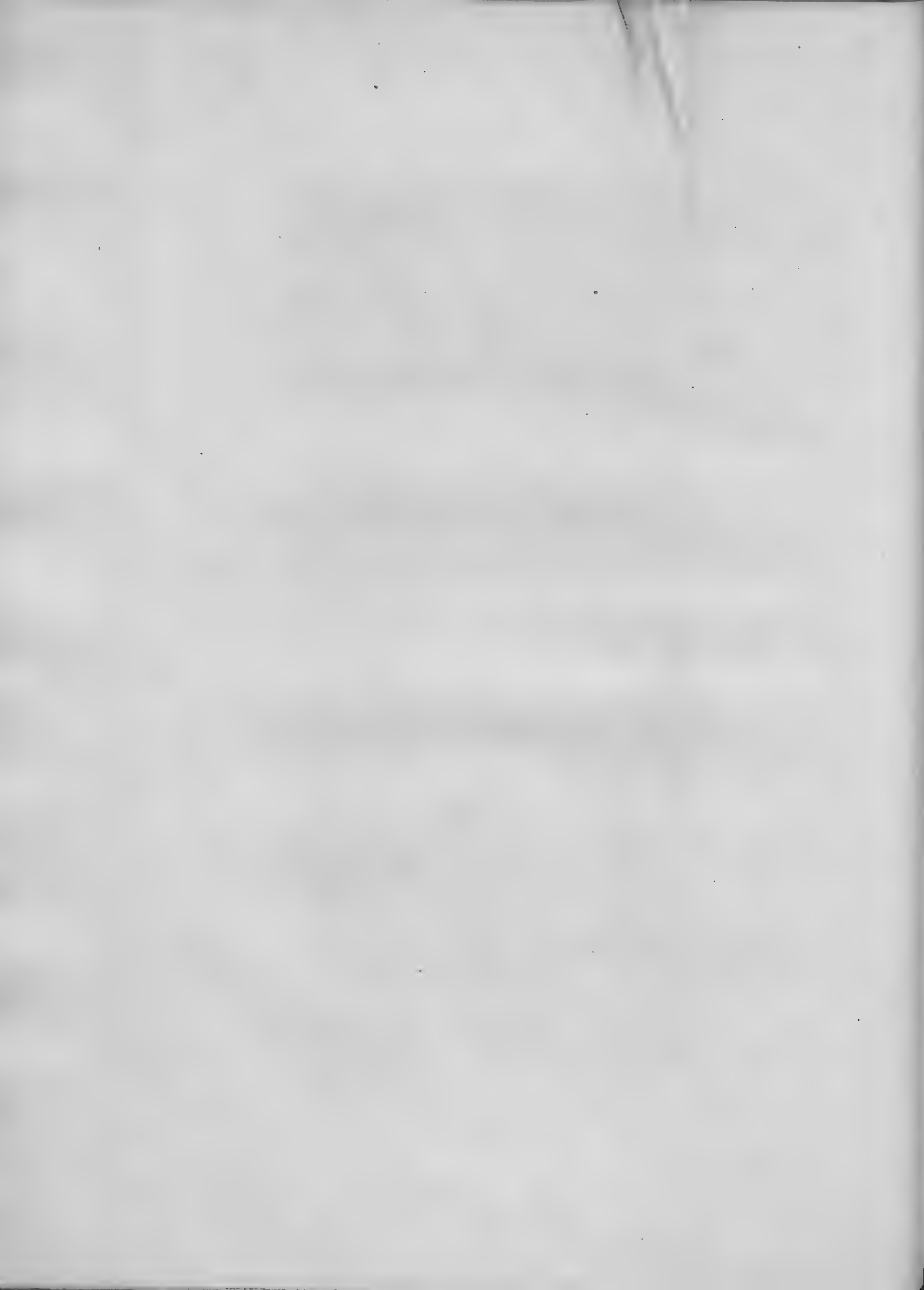


PLATE V.



The Scale of this System is equal to one Third of the former.

Here I must observe to you, as a Thing I judge may prove of great Consequence with regard to the System of Comets, which is as yet very imperfect: That I am strongly of Opinion, that the Comets in general, through all their respective Orbits, describe one common Area, that is to say, all their Orbits with regard to the Magnitude of their proper Planes, are mathematically equal to one another; which, if it once could be proved, and confirmed by Observation, the Theories of all the Comets that have been justly observed, might easily be perfected, and their Periods at once determined, which now we can only guess at, or may wait whole Ages for more Certainty of. What leads me to believe, that this may prove to be really the Case is this.

I find by Calculation, that the Orbits of the two last Comets, whose Elements have been most corrected by Sir *Isaac Newton* and Dr. *Hally*, are to one another, according to their Numbers, nearly as * 13 to † 17, notwithstanding one of them is one of the most erratick that ever came under our Observation; and the other one of the most neighbouring to the Sun.

But it is well known to all Mathematicians, that the first of these Comets moved in so eccentric a Trajectory, that the least Error in its almost incredible Proximity to the Sun will produce a very sensible Difference in the Area of the Orbit: And accordingly, if we moderate the Perihelion Distance of this Comet, by making it but 1000 instead of ‡ 612, which is but increasing it a $\frac{1}{35000}$ th Part of the great Radius of the Orbit, (which is an Error every Astronomer will readily grant is very easily made) and we shall find the Orbits of the said two Comets to be exactly equal.

Further, I must inform you, that the Comet of 1682, which the above compared with, seems to have been so accurately observed, that it does not appear to have altered its Perihelion Distance half a 68th Part in one intire Revolution. Now, if we can with any Show of Reason, and a Probability on our Side, bring the Areas of these two extream Comets, as I may call them, to an *Equality*, sure we may conclude, it is a Subject highly worthy to be more considered and enquired into.

PLATE

* 1316539,968282 Comet of 1680.

† 1708155,4644 Comet of 1682.

‡ The Number in Dr. *Hally's* Synopsis.

P L A T E VI.

Is a true Representation of the satellite Systems, proportionable to one another, and to the Orb of the Sun's Body, that a just Idea of the Distances of those secondary Planets, may be easier had from their respective primary ones.

S represents the solar Body with its Atmosphere. *Fig. 1.* is the System of *Saturn* from the same Scale. *Fig. 2.* that of *Jupiter* from ditto. And *Fig. 3.* the Orbit of the Moon round the Earth, in the same Proportion.

But as you can have but a very imperfect Idea of the Magnitude of these last Circles, with regard to the Body of the Earth or Moon,

P L A T E VII.

Is a true Projection of their real Globes, at their proper Distance from each other, with their common Center of Gravity, and the Point and Line of equal Suspension betwixt them, *viz.*

A, represents the Globe of the Earth.

B, that of the Moon.

C, Point, and C D, Line of equal Suspension betwixt them.

E, Common Center of Gravity, which describes the *Orbis Magnus*.

E, F, and B, G, is the Orbit of the Moon.

Farther, that nothing may be wanting to give a true Notion of the whole together,

P L A T E VIII.

Is a proportional Drawing of all the primary and secondary Planets together, distinguished by their Characters, proper to attend a Globe of twelve Inches Diameter, such a one being supposed to represent the Sun.

P L A T E IX.

Is an exact Scheme of the principal known Comets, in just Proportion, to the Globe of the Earth represented at A, with the Nuclius, and Part of the Tail of the Comet of 1680, B, as it was observed in its Assent from the Sun, *viz. a a* the Comet's natural Atmosphere, *z z z*, the *Denser Matter* winding itself into the Axis of the Train *x x*, the inflam'd Atmosphere and Tail dilated near the Sun. C, represents the Ball of the Comet of 1682, D, that of 1665, E, that of 1742, and F, the Head of the Comet of 1744.

And again, that you may have some Notion of the apparent Magnitudes of all these Planets and Comets, &c. as they appear at the Earth,

P L A T E

PLATE .VI.

Figure .I .

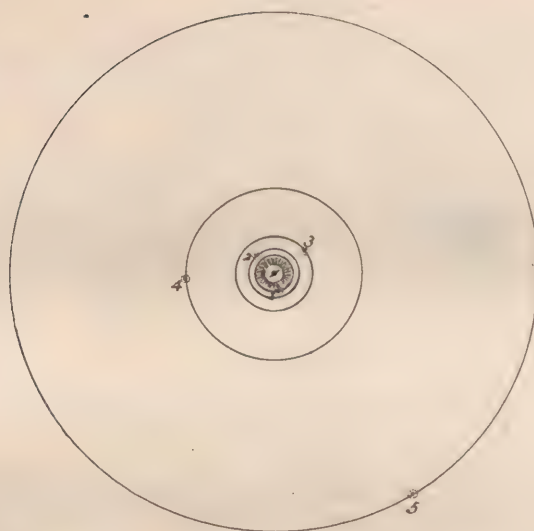
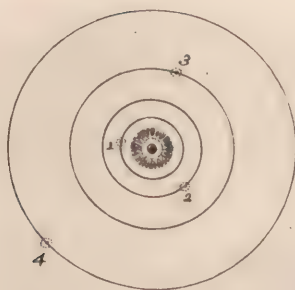
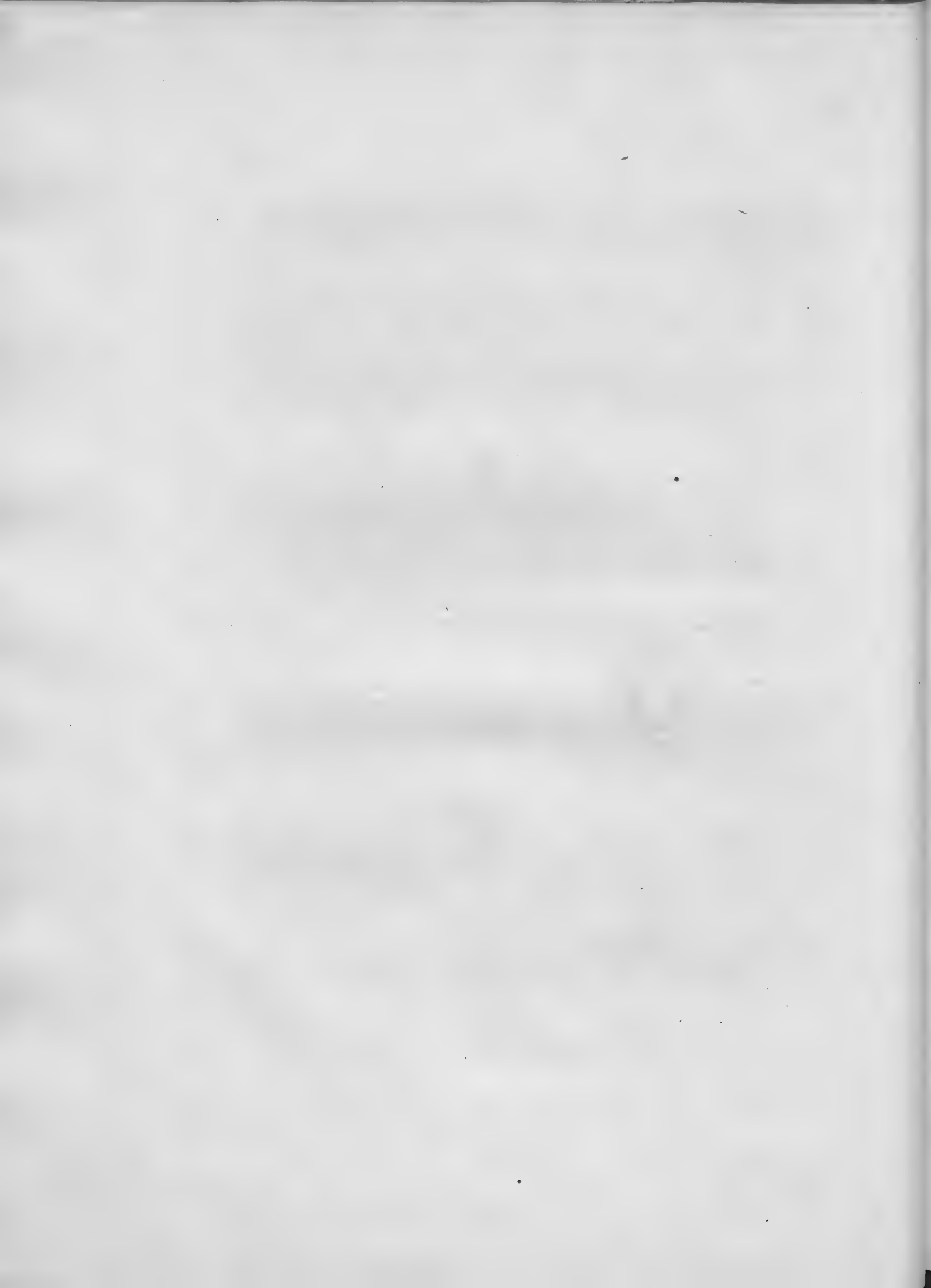


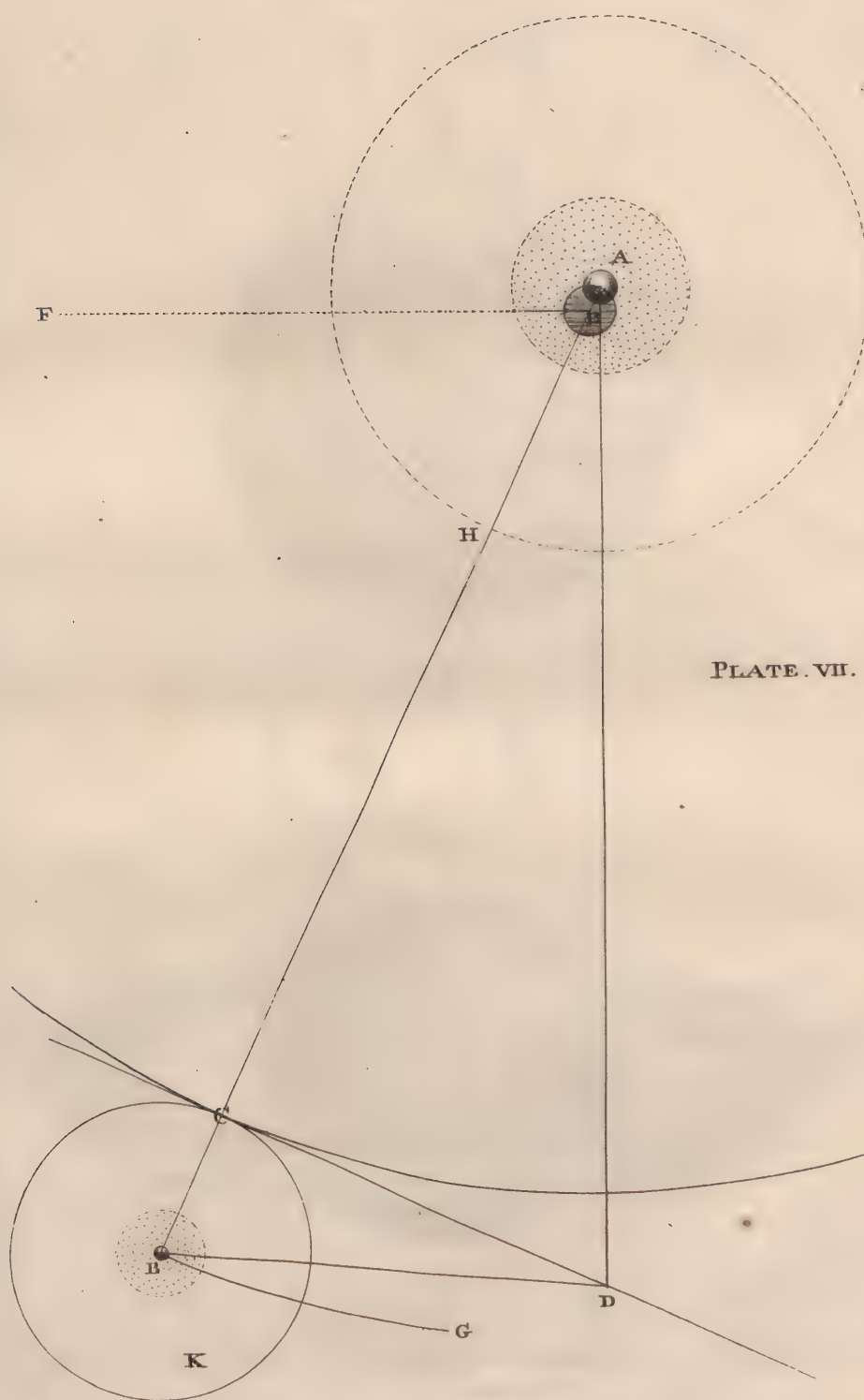
Fig III



Fig. II .







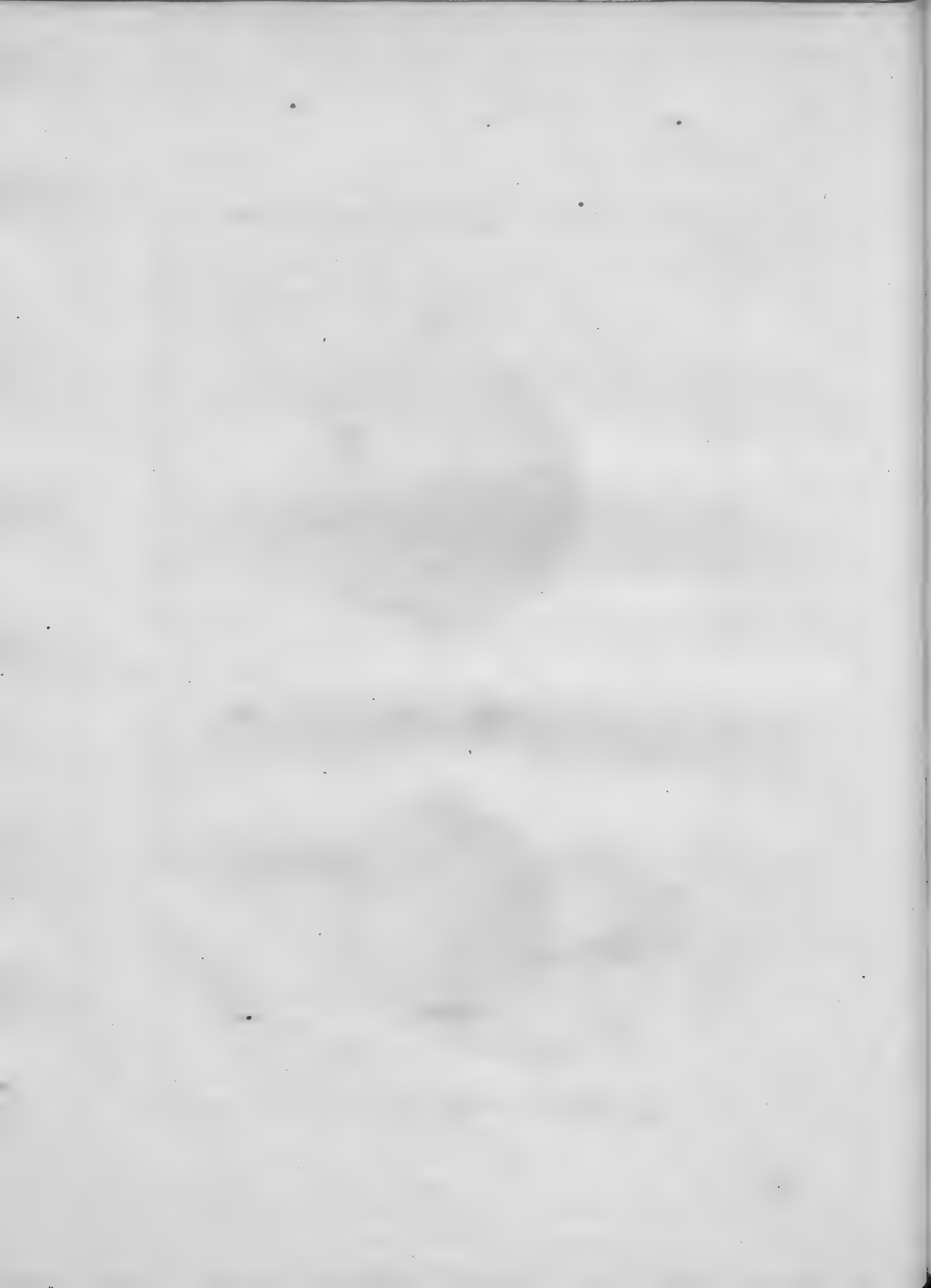
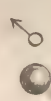
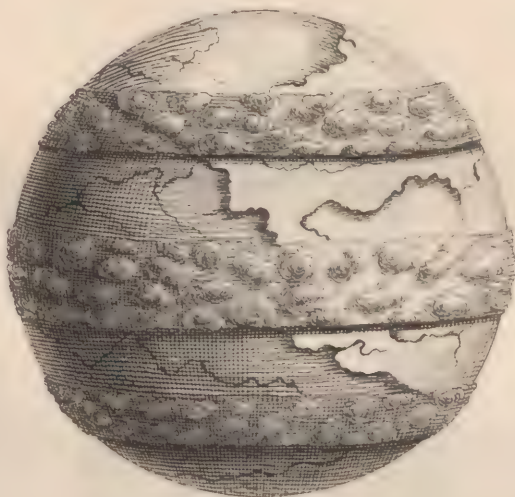


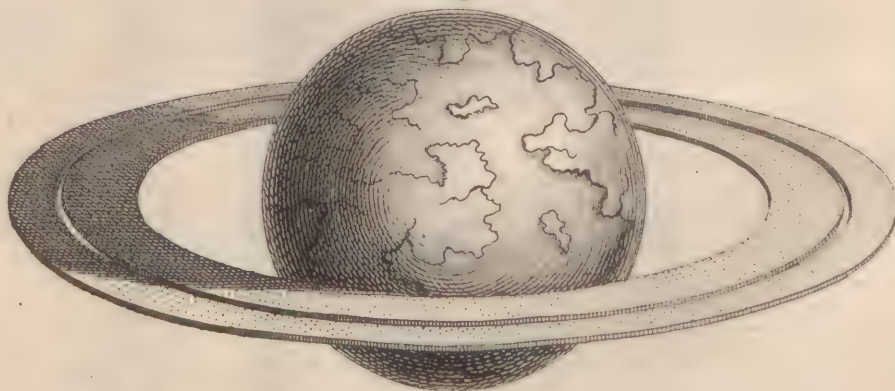
PLATE VIII.



♂



♂



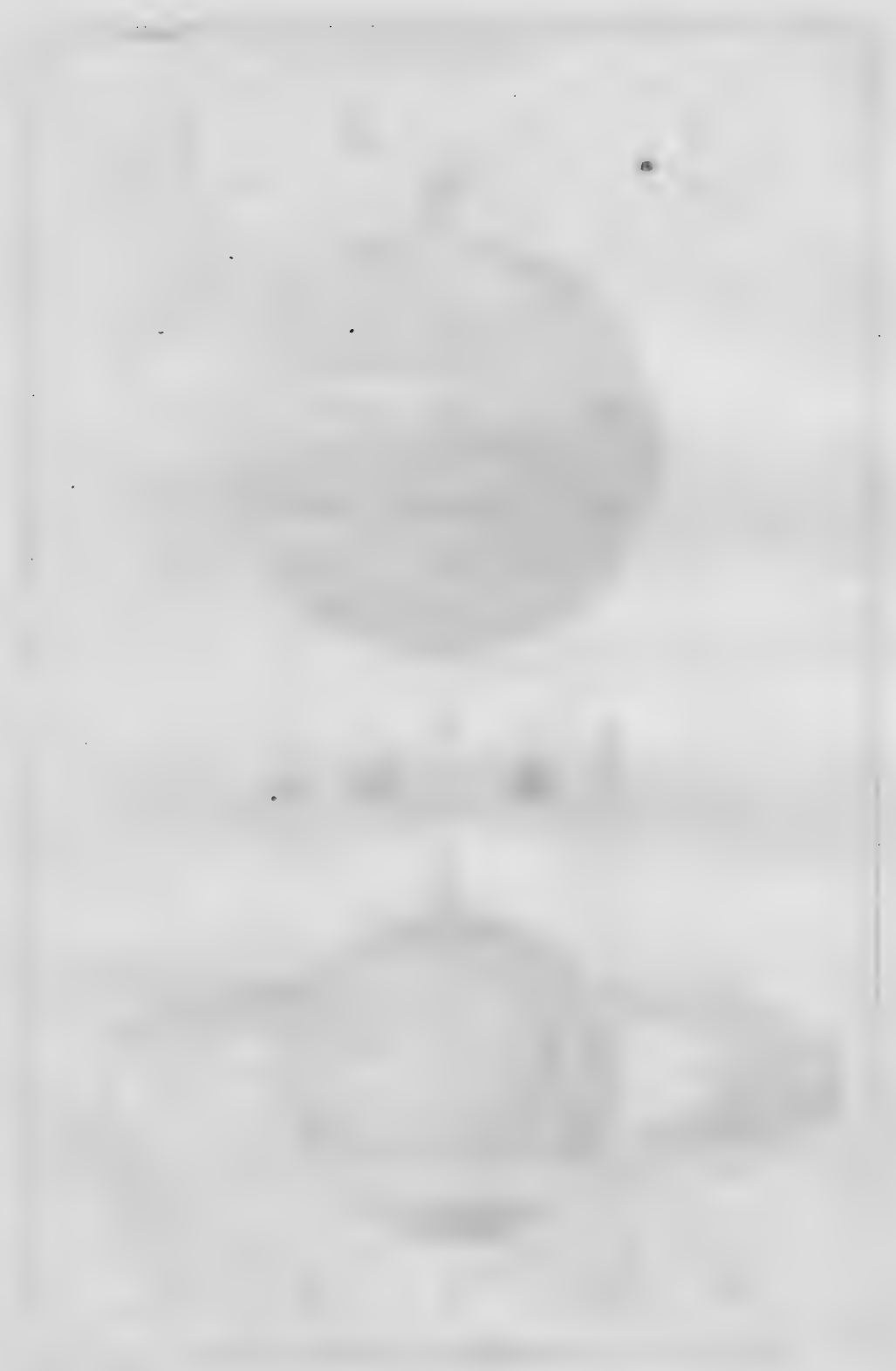
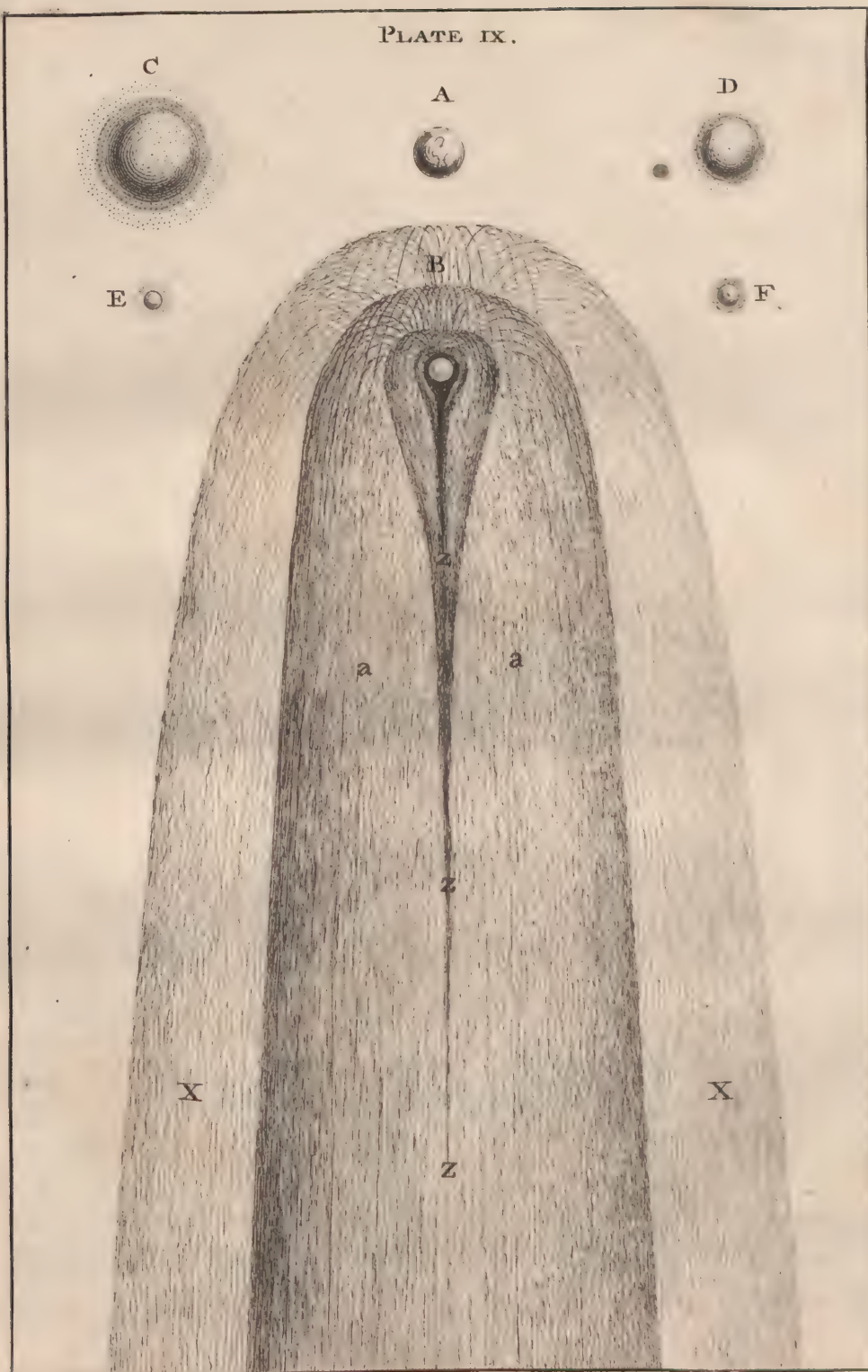


PLATE IX.









P L A T E X.

Represents the Sun and Moon in the just Proportion of their mean Diameters, with two of the Comets A and B, and the five erratick Planets, as they are observed at the Earth, in a middle State of their Distances from it.

For a more full and particular Description of all the Parts of the solar System, and of the home Elements of Astronomy in general, I refer you to my *Clavis Cælestis*, &c. where every thing concerning the Planets, Comets, and Stars; and their real and apparent Motions, are at large represented, explained, and accounted for, for the Benefit of such as have not made the Mathematicks their regular Study.

Now, to convince you that the Planets are all in their own Nature no other than dark opaque Bodies, reflecting only the borrowed Light of the Sun, I must recommend to your Observation, this natural and simple Experiment, which almost any Opportunity of seeing the *Moon* a little before the Full, will put into your Power to make; but best and easiest when the Sun is in any of the North Signs, *i. e.* in *Summer*.

At such a time, the Sun being near setting, the Moon will appear in the eastern Hemisphere; and if there be any bright Clouds northward, or southward near her, you will plainly perceive, that the *Light* of the one is of the same Nature with that of the other; I mean the Light of the Moon, and that of the Cloud. To me there never appeared any Difference at all; and I am perswaded, were you to make but two or three Observations of this kind, which is from Nature itself, a sort of ocular Demonstration, you cannot fail of being convinced, that the Moon's Light, such as it is, without Heat, can possibly proceed from no other Cause than that which illumines the Cloud: For if the Clouds, whose Composition we know to be but a thin light Fluid, formed of condensed Vapours only, is capable of remitting so great a Lustre, how much more may we not allow the Moon, which, Length of Time, and many other Circumstances, have long confirmed to be a durable and solid Body.

The Increase of her Lustre, indeed, during the Absence of the Sun from us, to a less penetrating Genius than your's, may possibly afford some trifling Ground of Objection to the above Conclusions, as being drawn from the Phænomena of Day-light only; by reason in the Night, we have no Clouds in equal Circumstances to compare with her.

But this I need not tell you, is all owing to her being seen through a darker Medium, and not to any real Increase of natural Light emitted from the Sun. As a Proof of which, were it necessary, you need only, shut out the Rays of the Atmosphere, by the Help of a sufficiently
long

long Tube; and the Moon, or any other celestial Body, will appear through it, as bright in the Day-time as in the Night.

Thus all light Bodies of inferior Lustre, whether shining by their own natural Radiences, or by a borrowed Reflection, partake of the same Advantage, when removed from the more potent Influence of a superior one; and hence it is, that the **Aura Ætherea* shines out most manifest, when the Body of the Sun himself is hid, the Stars, and the *Via Lactea* most lively and numerous in the Absence of the Moon, and those Exhalations, or Meteors, vulgarly called Falling-stars, become only visible (like Glow-worms) in the Night.

Here it may not be improper to tell you, that the Clouds are to us in effect no other than as so many Moons, whereby we have our artificial Day prolonged to us several Hours after the Sun is set, and likewise produced as much sooner before he rises; and were they to ascend by still stronger Power of Exhalation to an Elevation, all round the Atmosphere, so as to form a Sphere equal to four Times the Globe of the Earth, there would then be no such Thing as real nocturnal Darkness to any Part of the World.

The lunar Light then we may very justly conclude, proceeds originally from the Sun: And notwithstanding many more Arguments might be drawn from the Demonstration of her Phases, Eclipses, &c. to prove it, yet none of them need here be added, to what has been already said, to convince you of the Truth of it. This being granted, let us now consider what Effect this, or a like Quantity of borrowed Light, would have, when removed to a much greater Distance.

I may, I think, suppose, that you know so much of Opticks as to understand, that all visible Objects apparently decrease in Magnitude, as their Distance from the Eye increases. Consequently, that, if the Moon's Orbit was placed as far again from the Earth as it really is, her Globe, or rather *Disk*, would then seem to be but half as big as to us she now appears to be, and of course still farther, were she placed at ten times the Distance she is known to revolve at, her apparent Diameter would be reduced to a tenth Part only of what it now appears to be in her present Orbit, that is, one hundred Times less in visible Magnitude than her neighbouring Disk is found to be where it now is seen. And such, but something less, the two Planets *Venus* and *Jupiter*, which are frequently, in their Turns, our Morning and Evening Stars, appear to be through a common Telescope.

Now

* An *Helios*, or golden Light, always attending the Sun, and supposed to spread itself all round his Body in the Direction of his Equator, was very visible during the total Darkness of the Eclipse of 1715, and may be always seen about the Autumnal Equinox.

Now these two Planets, together with the other three, which we find moving in regular Orbits round the Sun, are all found subject to the same * Changes of *Phænomena*, in their various Aspects with the Sun; and who can doubt but that they are all of the same or like Nature? But you'll say, perhaps, how are we sure that *Venus* and *Jupiter* have no native Light of their own, since many of the ancient Philosophers, and in particular *Anaximander*, allowed even the Moon to have some; and besides, in Philosophy, as well as in Logick, I think you hold there is no proving a Negative, at least at such a Distance.

To make you conceive the Impossibility of such a Light, and next to a Demonstration, convince you of the Unnaturalness of such a Supposition, I must put you in mind, that some time ago, when I was last in the Country with you, I think it was about the latter End of Autumn, near the Winter Solstice, as we were walking one Evening, I bid you take notice of the Moon, which was then near setting, and about two Days old. You may remember, her whole Globe appeared to us very conspicuously within a manifest Circle. You immediately told me, that that kind of Phænomenon the Country People called a *Stork*, or the old Moon in the new one's Arms. This I then endeavoured to explain to you, and I think made you sensible it was intirely an Effect of the Earth's, and an Appearance always to be expected at that Time of the Year. The Earth being then in the State of a Full-Moon to that Part of the lunar Orbit, and near her Perihelion, at which time, the Earth sends back a Reflection to the † Moon twenty-five times more potent than that of the Moon to us.

Now the Planet *Venus*, from undeniable Principles of Geometry, is allowed to be nearly such another Globe as the Earth is; and since the Earth, as I have just now related, is found to reflect much more Light to the Moon, by reason of her superior Magnitude, than the Moon can possibly reverberate to Earth again; and since also 'tis plain, the Earth has no Light of its own, why then should we imagine *Venus* to be endowed with a Lustre, which we can prove to be no more than a similar Body, and governed by the same Laws as the Earth is?

Anaximander's Mistake, in supposing the Moon in some small Degree a radiant Body of itself, lay, in not considering, that the faint Illumination here described, and visible all over her Globe, soon after almost every Conjunction with the Sun; and probably in Eclipses, also proceeded from the Earth; but the thing I think is too evident to expect any sort of Contradiction,

* *Venus* and *Mercury* in every Heliocentrick Revolution, perform all the Changes of our Moon in a like Gradation and Defection of Light, both horned and gibos'd.

† Their Diameters being nearly as 1 to 5.

tradition, therefore I hope you will admit it as a Truth, and consequently take it for granted, that the planetary Bodies in general, are meer terrestrial, if not terraqueous Bodies, such as this we live upon; which is the Thing I have chiefly in this Letter attempted to demonstrate, or have rather explained; and now I hope, for the future, you will receive the Idea of a Plurality of Worlds more favourably, and look upon astronomical Conjectures in a less ridiculous Light than you used to do, especially since you must allow, they give our unlimited Imaginations a like all endless Field of Contemplation, not only full of the wonderful Works of Nature, but also of a visible Providence.

I think I cannot conclude this Letter to you more properly, than with the following fine Lines of Mr. Addison's from the *Spectator*, Vol. VI. No. 465. which I hope you are not so polite as to look upon as an unfashionable Quotation.

The spacious Firmament on High,
 With all the blue ethereal Sky,
 And spangl'd Heav'ns, a shining Frame,
 Their great Original proclaim:
 Th' unwearied Sun, from Day to Day,
 Does his Creator's Pow'r display,
 And publishes to ev'ry Land
 The Work of an Almighty Hand.
 Soon as the Ev'ning Shades prevail,
 The Moon takes up the wond'rous Tale,
 And nightly to the list'ning Earth,
 Repeats the Story of her Birth:
 Whilst all the Stars that round her burn,
 And all the Planets in their Turn,
 Confirm the Tidings as they roll,
 And spread the Truth from Pole to Pole.
 What though, in solemn Silence, all
 Move round the Dark terrestrial Ball?
 What tho' nor real Voice nor Sound
 Amid their radiant Orbs be found?
 In Reason's Ear, they all rejoice,
 And utter forth a glorious Voice,
 For ever singing, as they shine,
 "The Hand that made us is divine."

And am, &c.

LETTER

LETTER THE FOURTH.

Of the Nature of the heavenly Bodies continued, with the Opinions of the Antients concerning the Sun and Stars.

S I R,

YOU tell me you begin to be a tolerable good *Copernican*, and would now be glad to have my Opinion further upon the Nature of the Sun and Stars, with regard to the Suggestion of their being like Bodies of Fire. This you say will go a great Way towards confirming you in the Notion you have begun to embrace of a Plurality of Systems, and a much greater Multiplicity of Worlds than our little solar System can admit of. Besides, shewing in a very evident Light, that the Authorities cited in my first Letter are founded upon the clearest Reason.

Anaxagoras, you say, believed the Sun to be a Lump of red-hot Iron; *Euripides* thought it a Clod of Gold; and others still more ridiculously have imagined it to be a dark Body, void of all Heat. That the Sun is a vast Body of blazing Matter, notwithstanding the various Opinions of those primitive Sages, will, I think, hardly admit of a Question: Since the known Warmth of his prolific Beams, and the visible Effect of the Burning-glass, puts it quite out of the Power of our present Set of Senses, at least to argue against it; and how reasonably we may imagine the Stars to be all of the same or like Nature, will sufficiently appear from these following Considerations: First, it is well known to all Mathematicians, that any visible Object of any determined Magnitude may be reduced to the Appearance of * a physical Point, by removing the Eye of the Observer to a proper or proportionable Distance from it, within the finite View: And that the apparent Diameter of every luminous celestial Body, will always be diminished reciprocally, in Proportion to the Distance from the Eye, till they become altogether imperceptible.

E 2

Thus

* What is here meant by a physical Point, is a Point visible to the naked Eye, which human Art cannot divide; and so far it partakes of the Property of a mathematical one, which is only to be conceived, and not seen.

Thus the Disk of the Sun, which appears to us at Earth under an Angle of about half a Degree, if seen from the Planet *Saturn*, would appear not much bigger than the Planet *Venus* or *Jupiter*, in their most neighbouring Vicinity does to us; and consequently to an Eye placed in the Aphelion Point of the Orbit of the great *Comet* of 1680, his apparent Diameter would be so reduced as to seem but little bigger than the largest of the Stars; and by the same Analogy, or Way of Reasoning, admitting Space and Distance infinite, which I humbly apprehend is not to be disputed, were all the Matter in the Universe united, and conglobed in one Mass, with respect to ocular Sensation, it might be diminished so near to a mathematical Punctum, as to be almost adequate to our Ideas of Nothing.

This to any tolerable Optician, must be an evident Conviction of the Truth of the modern Astronomy, which now universally allow all those radiant Bodies the Stars to be of the same Nature with the Sun; and that as certainly they are no other than vast Globes of blazing Matter, all undoubtedly shining by their own native Light.

But as you have often objected to what has been said of the Distance of the Stars in general, and may possibly from a Supposition, that they are, or may be, much nearer to us, infer, that their Light, like that of the Planets, may be also borrowed from the Sun, or from some other radiant Body, which, from the Nature of the Supposition, must of Consequence be invisible to us, I judge it will not be amiss to throw a few demonstrative Arguments in your Way, in order to lead you a little out of the Path of an early Prejudice, and draw you as it were by Degrees through the Dawn of astronomical Reasoning, out of your original Error, and rescue your Imagination from the false Notions imbibed from Phenomena only in your younger Years. This I guess cannot fail of reconciling you to this more rational Way of Thinking, and make you acquainted with Truths of much Consequence, which perhaps you have yet been an intire Stranger to. The grand *Deceptio Visus*, which I must first endeavour to remove, and which as a sort of Paradox in Nature, has, as I may say, imprisoned the Understanding of many superficial Reasoners, and in general all incurious Men, is this.

Most People are too apt to think originally, that as the Heavens appear to be a vast concave Hemisphere, that the Stars must of course, as of Consequence, be fixed there, like so many radiant Studs of Fire, of various Magnitudes; and take it for granted, chiefly designed for no other Purpose than to deck and adorn the Canopy of our Night. This was long ago the Opinion of *Thales* the *Milesian*, and wants not the Authority of many

many of the Antients to back it. Others, in particular * *Ptolomy* of *Pe-lusium* in *Africa*, who from his Experience in this Science, is called by some the Prince of Astronomers, believed them to be Loop-holes in the vast solid celestial Firmament, emitting the Light of the Crystalline Heaven through it to all within it. The famous *Diogenes*, Cotemporary with *Plato*, conceived them to be of the Nature of Pumice-stones, and inclined to an Opinion, that they were the *Spiracula*, or Breathing-holes of Heaven. *Anaxagoras* thought them Stones snatched up from the Earth by the Rapidity of its Motion, and set on Fire in the upper Regions above the Moon.

But how ridiculous and absurd all these Opinions and Conjectures really are, will easily appear, if we but once consider the Nature of an unbounded Æther, and the amazing Property of infinite Space.

This, with what has been said before, will not a little assist your Imagination towards conceiving the Reasonableness of the Notion modern Astronomers are now confirmed in, of their being absolutely so many burning Balls, and which was no doubt, many Years ago, the Opinion of *Manilius*, as is evident from these Lines in his Poem of the Sphere,

For how can we the rising Stars conceive
A casual Production; or believe
Of the chang'd Heav'ns the oft renascent State
Sol's † frequent Births, and his quotidian Fate.

SHERBURNE.

And again in the same Poem:

The fiery Stars, and Æther that creates
Infinite Orbs, and others dissipates.

Zoroaster,

* *Ptolomy* supposed two Heavens above that of the fixed Stars, which he called the eighth; viz. a ninth, the Crystalline, and a tenth the *Primum Mobile*. See Letter the second.

The sacred Sun, above the Waters rais'd,
Thro' Heav'ns eternal, brazen Portals blaz'd;
And wide o'er Earth diffus'd his chearing Ray,
To Gods and Men to give the golden Day.

HOMER.

† *Xenophanes* believed the Stars to be no other than Clods set on Fire, quenched in the Day-time, and rekindled in the Night.

Zoroaster, the first of all Philosophers we read of who studied the Stars, is reported to have believed them of a fiery Nature. *Empedocles* judged them to be Fire æthereal, struck forth in its Secrecion, and blazing in the upper Regions. *Plato* thought them Fire, with the Mixture of other Elements as Cements. *Heraclides* Worlds by themselves, of *Earth*, *Air*, and *Fire*; and *Aristotle*, simple Bodies of the Substance of Heaven, but more condensed.

But that I may not take up too much of your Time with Opinions that has been imbibed in the Infancy of Astronomy, and has long ago been exploded, I shall attempt but one Thing more to confirm your Sentiments in this new Doctrine.

First, that the Stars are all at a Distance, not to be determined by the utmost Perfection of human Art, is manifest from their having very little, or no sensible Parallax; and consequently, that any one of them is absolutely bigger or less than another, from the simple Laws of Opticks, cannot possibly come under our Observation to be ascertained; but that they all of them may be nearly of the same Size or Solidity, is as impossible, with any Shew of Reason to deny, since it is a known Principle in Geometry, that all visible Objects naturally diminish, as has been said before, or are magnified in a certain Proportion to their Distance from the Eye; and hence we may conclude, and not without Reason in its strongest Light to support us, that the smallest Stars, to the very least Denomination, are only removed respectively more distant from the Observer's Station; and that at least this we may be certain of, that they are all together undoubtedly an Infinity of like Bodies, distributed either promiscuously, or in some regular Order throughout the mundane Space: And, as *Marino* says,

Resplendent Sparks of the first Fire !
In which the Beauty we admire,
And Light of those eternal Rays,
The uncreated Mind displays.

It remains now I think to shew, and endeavour to prove, that the Stars are not only light Bodies of the Nature of the Sun, but that they are really so many Suns, all performing like Offices of Heat and Gravity, in a regular Order, throughout the visible Creation, in opposition to an Opinion
you

* Mr. *Bradley*, Astronomer-Royal, has, in a great measure, proved that the Aberration of the Stars hitherto mistaken for a Parallax, may arise from, and indeed seems to be no other than the progressive Motion of Light, and Change of Place to the Eye, arising from the Earth's annual Motion and Direction.

you have formerly hinted at, of their being in another Sense of a secondary Nature.

All Objects within the sensible Sphere of the Sun's Attraction, or Activity, are in some measure magnified by a good Telescope: But the Stars are all placed so far without it, that the best Glasses has no other Effect upon them than making them appear more vivid or lively, but all innate opaque Bodies, reflecting only a borrowed Light from some primary one, contrary to this Property, are all observed to lose their Light, in the same Proportion, as they are magnified, and through all Glasses become more dull than otherwise they appear to the naked Eye: And hence we may infer, without any further Evidence, that the Stars are all light Bodies endowed with native Lustre; and that Bodies, like the known Planets, from the same Reasoning, it is as clear they cannot be, because their Distance, though uncertain as to the Truth of the whole, yet such a Part of it as cannot be denied, would render them all in such a Case invisible.

A Proof of this will plainly present itself, if we consider the Course of the known Comets, who all of them, without Exception, become imperceptible, and intirely disappear; though most of them much bigger than the Earth, or any of the lesser Planets, long before they arrive at their respective Aphelions.

But we are under a kind of Necessity to believe them either Suns or Planets, that is either dark or light Bodies; and since I have shewn the Improbability; nay, I may venture to say, the Impossibility of their being the first, it is natural sure to conclude, that they must be of the last Sort; and I am persuaded, if you but once consider how ridiculous it is to imagine so vast a Number of Bodies, all rolling round a Number of invisible Suns, which must otherwise be the Case, since they are seen on all Sides of ours, and cannot possibly be enlightened by him, or any, how all of them, by any one else, you cannot possibly have any sort of Difficulty in this Determination: But that no Arguments may be wanting to enforce your Belief of what is here concluded, it will not be amiss to put you in Mind of an optical Experiment or two, which cannot fail of convincing you of the vast Probability of what is here asserted of them; and next to a moral Certainty, demonstrate the Truth of what so many of the best Astronomers have advanced, as before namely, that the Stars are all, or most of them, Suns like ours.

Place any concave Lense before your Eye, and you will find all visible Objects will appear through it, as removed to a much greater Distance than they really are at, and reciprocally as much diminished. Now, if
you

you look upon one of these Glasses of a proper Concavity, opposed to the Sun or Moon, you will respectively have the Appearance of a real Star or Planet, the first exhibited by the Body of the Sun, the other by the Moon, and either more or less diminished in Proportion to the Surface of the Sphere the Glas is ground to.

For Example, a double Concave, or Glas of a negative Focus, ground to a Sphere of about three Inches Diameter, will if opposed to the Sun's Disk at a proper Distance from the Eye, help you to a very good Idea how the Sun appears to the Planet *Jupiter*; and if a proper Regard be had to the Distance of the Planet *Saturn*, a Lense still more concave may be formed to give a just Idea of the Sun's Appearance to *Saturn*. Again, one much more concave than the former, proportioned to the Orbit of *Mars*, will naturally exhibit the solar Body, as seen from that Planet.

To the Planet *Venus* and *Mercury*, the Sun appearing much larger than to us at the Earth, to have any tolerable Notion of his varied Phænomena to them, it will be necessary to procure Glasses of a suitable Convexity, ground to reciprocal Concaves, which may easily be done to any Focus, so as to shew how the Sun, naturally appears to the Inhabitants of those two Planets.

The various Appearances of the Planets themselves to us at the Earth, may also well enough be had, if through Glasses analagous to their respective Distance and Magnitude, we look at the Moon, particularly all the Phases of *Venus*, and even of *Mercury*, and the Gibosity of *Mars*, &c. may be justly and beautifully represented at different Ages of the Moon, as those Planets appear through the largest and best Telescopes.

This Way you may convince even your Friend * * *, who you tell me has reasoned all his Senses useless, and yet continues so great an Atheist in Astronomy, as not to believe the World turns round upon its Axis, though he gives no better Reason for it than that of his not being giddy.

After all these Arguments, I hope no new Difficulties will arise to retard your Belief, or deprive the Stars of their solar Nature, so justly due to them: This Point gained, the next Thing to be considered is, whether all those glorious Bodies, the far greater Part of whom being invisible to the naked Eye, were made purely and purposely for the sole Use of this diminutive World, our little trifling Earth.

—Men, conceited Lords of all,
Walk proudly o'er this pendent Ball,
Fond of their little Spot below,
Nor greater Beings care to know,
But think those Words, which deck the Skies,
Were only form'd to please their Eyes. Duck.

The

The very Supposition not only implies a profound Ignorance of the Divine Attributes, but is as impious, and full of Vanity, as it is erroneous and absurd, and even a Blindness sufficient of itself, were there no other Cause for it, to introduce Idolatry in the Minds of Mortals, by sinking the divine Nature so near to the human.

It being granted that the Stars are all of the same Kind, I think it may be agreed, that what we evince of any one may be allowed to be true of any other, and consequently of all the rest. This *Postulata* gained, I shall next proceed to enquire what the real Use and Design of so many radiant Bodies are, or may be made for.

The Sun we have justly reduced to the State of a Star, why then in Reason should he have his attendant Planets round him, more than any of the rest, his undoubted Equals? No Shadow even of a Reason can be given for such an Absurdity.

May we not with the greatest Confidence imagine, that Nature as justly abhors a *Vacuum* in Place, as much as Virtue does in Time? Surely yes: And by supposing the Infinity of Stars, all centers to as many Systems of innumerable Worlds, all alike unknown to us; how naturally do we open to ourselves a vast Field of Probation, and an endless Scene of Hope to ground our Expectation of an *ever-future* Happiness upon, suitable to the native Dignity of the awful Mind, which made and comprehends it; and whose Works are all as the Business of an Eternity?

If the Stars were ordained merely for the Use of us, why so much Extravagance and Ostentation in their Number, Nature, and Make? For a much less Quantity, and smaller Bodies, placed nearer to us, would every Way answer the vain End we put them to; and besides, in all Things else, Nature is most frugal, and takes the nearest Way, through all her Works, to operate and effect the Will of God. It scarce can be reckoned more irrational, to suppose Animals with Eyes, destined to live in eternal Darkness, or without Eyes to live in perpetual Day, than to imagine Space illuminated, where there is nothing to be acted upon, or brought to Light; therefore we may justly suppose, that so many radiant Bodies were not created barely to enlighten an infinite Void, but to make their much more numerous Attendants visible; and instead of discovering a vast unbounded desolate Negation of Beings, display an infinite shapeless Universe, crowded with Myriads of glorious Worlds, all variously revolving round them; and which form an Atom, to an indefinite Creation, with an inconceivable Variety of Beings and States, animate and fill the endless Orb of Immensity.

F

That

That the fidereal Planets are not visible to us, can be no Objection to their actual Existence, and being there, is plain from this; it is well known, that the Stars themselves, which are their Central, and only radiant Bodies, are little more to us at the Earth, than mathematical Points. How ridiculous then is it to expect, that any of their small opaque Attendance, should ever be perceived so far as the Earth by us; and besides, to show the Impossibility of such a Discovery, we need only consider, what is, and what is not to be expected, or known in our own home System. All the Planets in this our sensible Region, every Astronomer knows, is far from being visible to one another, in every individual Sphere; for to an Eye at the Orb of *Saturn*, this Earth we live upon, which requires Years to circumscribe, and Ages to be made acquainted with, and is far from being yet all known, cannot possibly from the above Planet be seen: And further, since *Saturn* and *Jupiter*, two of the most material and considerable Globes we know of, except the Sun himself, are Bodies apparently of the same kind, and are observed to have each a Number of lesser Planets moving round them; why may we not expect with equal Certainty and Propriety, that all other Bodies, under the same Circumstances, are in like manner attended; that is, seeing the Sun is found to be the Center of a System of Bodies, all variously volving round him? where lies the Improbability of his fellow Luminaries, the Stars, being surrounded in like sort, with more or less of such Attendance.

I shall offer but one Thing more to your Consideration in this Affair, and which I am in great Hopes will be sufficient to make you think these natural Suggestions a good deal more than probable, and that is this:

The modern Astronomers having, in a great measure, proved that the Stars are, in all respects, vast Globes of Fire like our Sun. Let us suppose a new-created Mind, or thinking Being, in a profound State of Ignorance, with regard to the Nature of all external Objects, but fully endowed with every human Sense and Force of Reason, suspended in *Æther*, exactly in the midway, betwixt * *Syrius* and the Sun; in which Case, both of these Luminaries would equally appear much about the Brightness of the largest of our Planets. Now should such a Being, determined either by Accident or Choice, arrive at this our System of the Sun, and seeing all the planetary Bodies moving round him, I would ask you what you think he would imagine to be round *Syrius*? Your Answer, I think I may venture to say, would not be *nothing*; and methinks I already hear you say, Why Planets such as ours.

* A Star of the first Magnitude in the greater *Dog*, and the most neighbouring to our Sun.

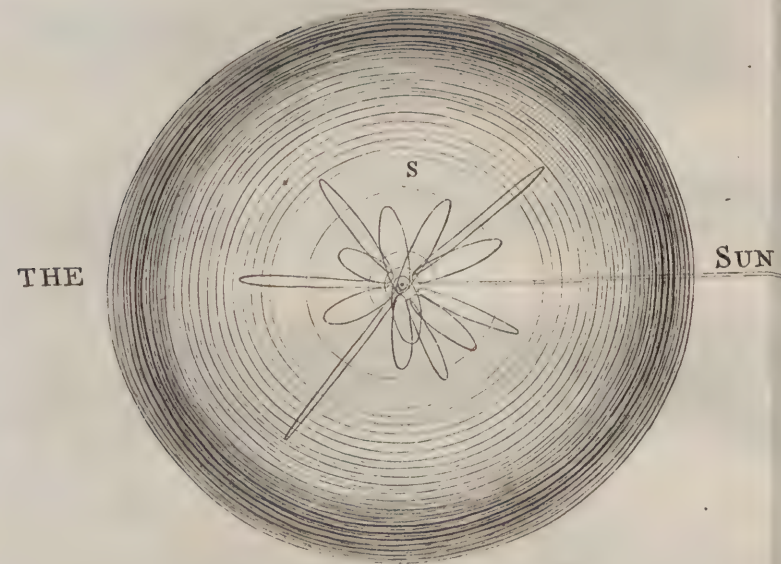


Figure 1.

P
ORBIT OF MERCURI.

PLATE XI.

Fig. 3.



SYRIUS

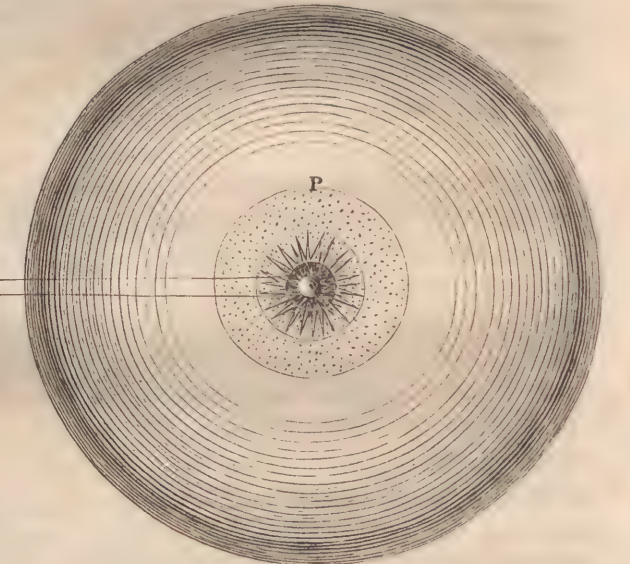
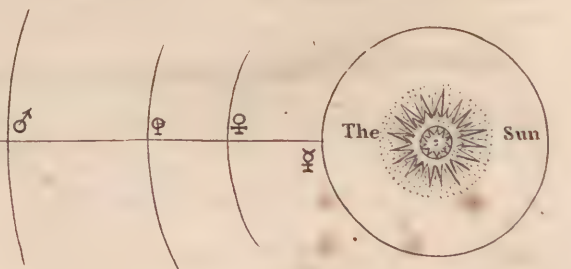


Fig. 2.

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2



P L A T E X I.

Is designed as a geometrical Scale to all the primary Parts of the visible Creation, with regard to the Distance of Orbits compared with the Globe of the Sun; by which at once may be conceived, and justly measured in the Mind, not only the mean Distance of the Planets with regard to one another, but also that of the Comets, and even the comparative Distances of the nearest of the Stars, which will, I guess, greatly help you to form an Idea of the vast Extent of Space necessary to comprehend the whole Creation.

Fig. 1. Is a Radius of the Orbit of *Mercury*, in true Proportion to the Body of the Sun represented at S, shewing at the same time a small Portion of the opaque Planet's Orbit, and the real Length of its Shadow at P.

Fig. 2. Is a Radius of the whole System of the Planets as far as the Orbit of *Saturn* in Proportion to a complete Orbit of *Mercury*, much less than the former; the former serving as a better known Scale to consider the amazing Distances of the more remote Planets by.

Lastly, *Fig. 3.* Is a Representation of the least possible Distance of *Syrius* and the Sun, proportionable to the Magnitude of the Sphere of our Comets, &c. represented at S, whereby it evidently appears, that as all the Planets of *Syrius* must be included within the small Sphere represented in the Center P, none of them could possibly be seen at the Sun, not only by reason of the Smallness of the Angle of Sustension, or Elongation, but also as being lost in the superior Light of *Syrius* himself, in so minute an Orb of Vicinity.

Consequently (as you must perceive) no Arguments can possibly be drawn to deny the Existence of such Bodies, with any Shew of Reason, from their not having been seen by us.

Here I must observe to you, that you cannot consider this Scale of Orbits too much before you look upon Plate XVII.

To conclude, it evidently seems to be the End and Design of Providence, by this visible Variety of Beings, to lift the Minds of Men above this narrow Earth, in Search of that powerful Being upon which we are all so much dependant; and the *Creator*, no doubt, in this vast Display of his Wisdom and Power, designed the amazing Whole, as the adequate Object of every Part, and as such equally open on all Sides, to the penetrating Progress of human Minds, and through the most extensive Faculty of Sense, the *Sight*, to draw our Reason and Understanding by Degrees, from finite Objects into Infinity; and as the last Result of celestial Contemplations place within our Reach, a certain Evidence of a future State, and the manifest Mansions of Rewards and Punishments, suited no doubt most equitably to all Degrees of Virtue, and to every Vice.

“ When I consider (says Mr. *Addison*, speaking as having taken particular notice of a fine Evening) that infinite Host of Stars, or to speak more philosophically of Suns, which were then shining upon me, with those innumerable Sets of Planets or Worlds, which were then moving round their respective Suns; when I still enlarge the Idea, and supposed another Heaven of Suns and Worlds rising still above this which we discovered; and these still enlightened by a superior Firmament of Luminaries, which are planted at so great a Distance, that they may appear to the Inhabitants of the former as the Stars do to us; in short, whilst I pursued this Thought, I could not but reflect on that little insignificant Figure which I myself bore amongst the Immensity of God’s Works:” This Reflection, I judge, as you are an Admirer of the Author, you will not look upon as impertinent in this Place, especially as it must enforce what I have endeavoured to shew you, namely, the Reasonableness of a Plurality of sidereal Systems, and their Multiplicity of Worlds; which, if you are yet in Doubt of, I hope you will at least forgive so well designed an Attempt with your usual Candour.

I am now prepared to proceed in the chief Design of this Undertaking, which is to solve the Phænomena of the *Via Lactea*; and propose in my next to answer more fully your farther Request.

I am, &c.



LETTER

LETTER THE FIFTH.

*Of the Order, Distance, and Multiplicity of the Stars, the Via Lactea, and
Extent of the visible Creation.*

S I R,

WE are told, and, if I remember right, it is also your Opinion, that three of the finest Sights in Nature, are a rising Sun at Sea, a verdant Landskip with a Rainbow, and a clear Star-light Evening : All of which I have myself often observed with vast Delight and Pleasure. The first I have frequently beheld, and always with an agreeable Surprize ; the second I have as often taken notice of, with no small Degree of Admiration ; but the last I shall never look up to without an Astonishment, even mixed with a kind of Rapture. The Night you last left us, this admirable Scene was in its full Beauty ; and, as *Milton* says,

Silence was pleas'd : now glow'd the Firmament
With living Saphirs ; *Hesperus* that led
The starry Host rode brightest.——

I found it was impossible to look long upon this stupendious Scene, so full of amazing Objects, and particularly the *Via Lactea*, which (the Moon being absent) was then in great Perfection, without being put in Mind of my Task. This surprizing Zone of Light being the chief Object I have undertaken to treat of and demonstrate.

This amazing Phænomenon which have been the Occasion of so many *Fables*, idle Romances, and ridiculous Opinions amongst the Antients, still continues to be unaccounted for, and even in an Age vain enough to boast Astronomy in its utmost Perfection.

What will you say, if I tell you, it is my Belief we are so far from the real Summit of the Science, that we scarce yet know the Rudiments of what may be expected from it. This luminous Circle has often engrossed my Thoughts, and of late has taken up all my idle Hours ; and I am now in
great

great Hopes I have not only at last found out the real Cause of it, but also by the same Hypothesis, which solves this Appearance, shall be able to demonstrate a much more rational Theory of the Creation than hitherto has been any where advanced, and at the same Time give you an intire new Idea of the Universe, or infinite System of Things. This most surprizing Zone of Light, which have employed successively for many Ages past, the wisest Heads amongst the Antients, to no other Purpose than barely to describe it; we find to be a perfect Circle, and nearly bisecting the celestial Sphere, but very irregular in Breadth and Brightness, and in many Places divided into double Streams.

* The principal Part of it runs through the *Eagle*, the *Swan*, *Cassiopea*, *Perseus*, and *Auriga*, and continues its Course by the Head of *Monoceros*, along by the greater *Dog* through the Ship, and underneath the *Centaur's Feet*, till having passed the *Alter*, the *Scorpion's Tail*, and the Bow of *Aquarius*, it ends at last where it begun.

PLATE XII, and XIII.

Represents the two Hemispheres, where its true Tract is distinguished amongst the principal Stars, and may easily be conceived by them to circumscribe and bisect the whole Heavens.

This is that Phænomena I am about to explain and account for; but before I proceed farther, I judge it will be no *improper Precognita*, to give you the Thoughts of the Antients upon it; the Relation perhaps may require some Patience; but I guess, that after reading such wild and extravagant Notions concerning it, you will naturally judge more favourably of the Conjectures of the Moderns upon it, and particularly of what is concluded in the succeeding Pages.

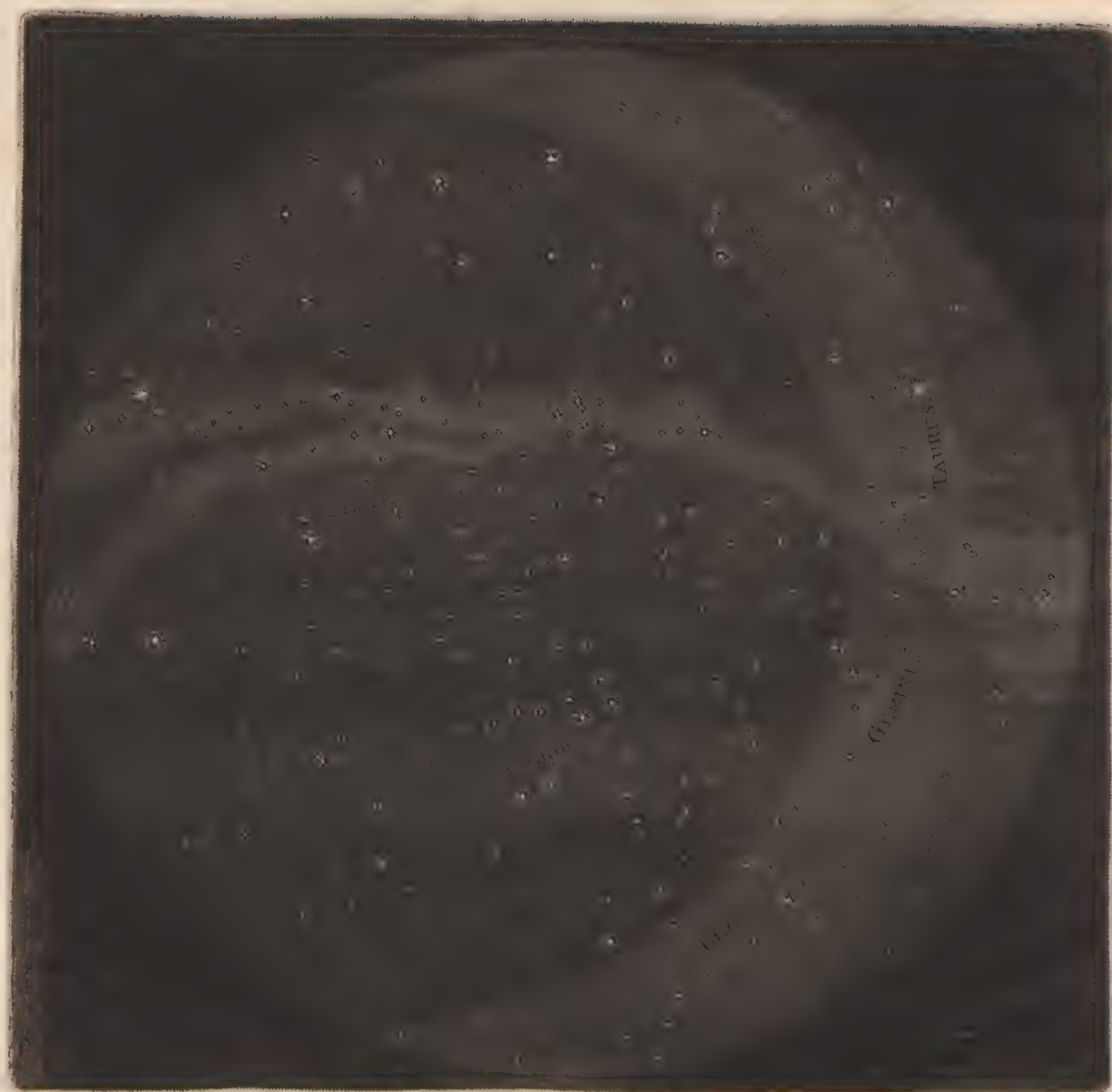
Theophrastus

* ——— Carried toward the opposed Bears,
Its Course close by the *Artick Circle* steers,
And by inverted *Cassiopea* tends;
Thence by the *Swan* obliquely it descends
The Summer Tropick, and *Jove's Bird* divides;
Then cross the Equator, and the *Zodiack* glides
Twixt *Scorpio's* burning Tail, and the left Part
Of *Sagittarius*, near the fiery Dart;
Then by the other *Centaur's* Legs and Feet,
Winding remounts the Skies (again to meet)
By *Argos' Top-sail*, and Heav'n's middle Sphere,
Passing the *Twins*, t' o'er take the Charioteer;
Thence *Cassiopea* seeking thee does run,
O're *Perseus* Head, and Ends where it begun.

SHER. MANILIUS.









Theophrastus * was of Opinion, that the Hemispheres, which, by many of the Antients were imagined to be solid, was joined together here; and that this was the soldering of the two Parts into one. † *Diodorus* thought it celestial Fire, of a dense and compact Nature, seen through the Cliffs or Cracks of the parting Hemisphere: But as *Manilius* says,

Astonishment must sure their Senses reach,
To see the World's wide Wound, and Heav'n's eternal Breach.

OENOPIDES ‖ believed it the ancient Way of the Sun, till frightened at the bloody Banquet of *Thyestis*. ** *ERATOSTHENES* supposed it *Juno's* Milk, spilt whilst giving Suck to *Hercules*. †† *PLUTARCH* makes it the Effect of *Phaeton's* confused Erratication; but I think it is plain †† *OVID* judged them to be Stars, and the ancient *Ethnicks* believed them to be the blissful Seats of valiant and heroic Souls.

— Valiant Souls, freed from corporeal Gives,
Thither repair, and lead æthereal Lives.

MANILIUS.

* *Macrobius*, lib. i. cap. 15.

Or meets Heaven here! and this white Cloud appears
The Cement of the close-wedg'd Hemispheres!

† The sacred Causes human Breasts enquire,
Whether the heavenly Segments there retire,
(The whole Mass shrinking, and the parting Flame
Thro' cleaving Chinks admits the stranger Flame.

‖ Or seems that old Opinion of more Sway,
That the Sun's Horses here once run astray,
And a new Path mark'd in their straggling Flight,
Of scorching Skies, and Stars adusted Light.

** Nor must that gentle Rumour be suppress'd,
How Milk once flowing from fair *Juno's* Breast
Stain'd the celestial Pavement, from whence came
This milky Path, its Cause shewn in its Name.

†† When from the hurried Chariot Light'ning fled,
And scatter'd blazes all the Skies o'erspread;
By whose Approach new Stars enkindled were,
Which still as Marks of that sad Chance appear.

†† A Way there is in Heaven's expanded Plain
Which when the Skies are clear, is seen below,
And Mortals by the Name of *Milky*, know,
The Ground-work is of Stars -----

MANILIUS.

Ovid's Met. lib. i.

But.

But * DEMOCRITUS long ago believed them to be an infinite Number of small Stars; and such of late Years they have been discovered to be, first by *Gallaleo*, next by *Keplar*, and now confirmed by all modern Astronomers, who have ever had an Opportunity of seeing them through a good Telescope.

PLATE XIV.

Is from an Observation I made myself, of a bright Part of this Zone near the Feet of *Antinous*; which, (by a Mistake of the Engraver) is, as it appears through a Tube of two convex Glasses. I saw it through a very good Reflector, and formed the Plan by a Combination of Triangles.

Milton takes notice of this Zone in a most beautiful Manner, where he describes the Creator's Return from his six Day's Work to Heaven, he introduces it as a Simile to express his Idea of the eternal Way, or Road to the celestial Mansions.

—— A broad and ample Road, whose Dust is Gold
And Pavement Stars, as Stars to thee appear,
Seen in the *Galaxie*, that Milky Way,
Which nightly as a circling Zone thou seest
Powder'd with Stars.

But to infer from their Appearance only, that they are really Stars, without considering their Nature and Distance; and that nothing but Stars could possibly produce such an Effect, may perhaps be assuming too much, when we have nothing but the bare Credit of the *Belgic* Glasses to support our Conjectures; and although this may be sufficient for any Mathematician, yet for your greater Satisfaction, I have thought proper to give two or three more evincing Arguments, to confirm these important Discoveries. *Democritus*, as I have said before, believed them to be Stars long before Astronomy reaped any Benefit from the improved Sciences of Optics; and saw, as we may say, through the Eye of Reason, full as far into Infinity as the most able Astronomers in more advantageous Times have done since, even assisted with their best Glasses: And his Conjectures are almost as old as the *philolaic* System of the Planets itself; the Construction of which, though attempted by many, none have ever yet been able to confute.

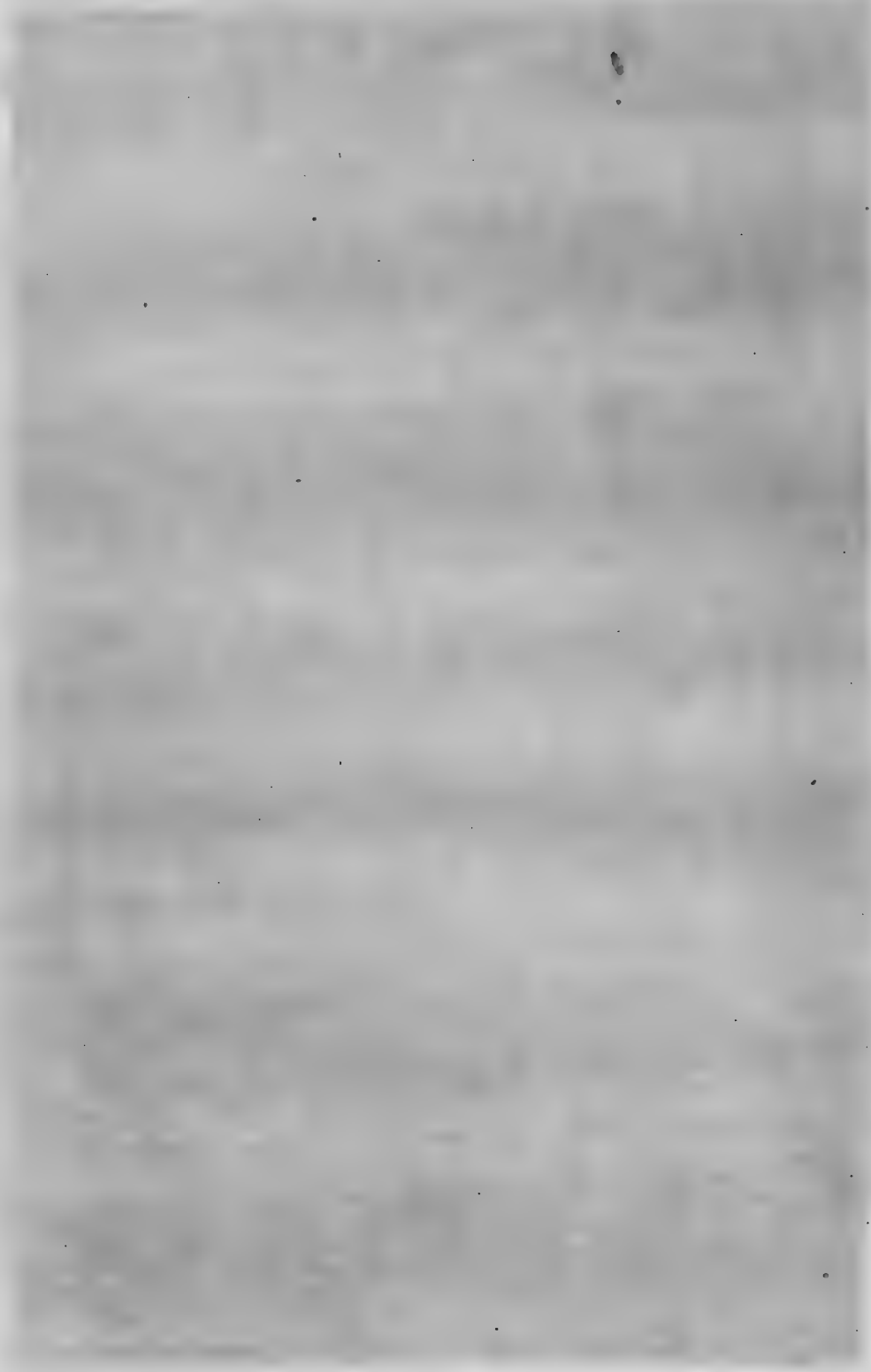
The Light which naturally flows from this Crowd of radiant Bodies is mixt and confus'd, chiefly occasioned by the Agitation of our Atmosphere, and from a Union of their Rays of Light, by a too near Proximity of their Beams, altogether they appear like a River of Milk, but more of a pelucid Nature, running all round the starry Regions.

For

* *Plutarch (in Placitis Philosoph.)*

PLATE XIV.





For in the azure Skies its candid Way
Shines like the dawning Morn, or closing Day.

There are also many more such luminous Spaces to be found in the Heavens of the same Nature with these, which we know to be Stars; in particular the *Nebulae*, or cloudy Star in the *Præsepe* of 36; a cloudy Star in *Orion* of 21; * a cloudy † Knot not far from this in the same Asterism of 80; in one Degree of the same Constellation 500, and in the whole Form above ‡ 2000. All of which are great Confirmations of the Truth of our Assertion, *i. e.* that this Zone of Light proceeds from an infinite Number of small Stars. Here it will not be amiss to observe, that it has been conjectured, and is strongly suspected, that a proper Number of Rays, meeting from different Directions, become Flame; and that hence it may prove not the Sun's real Body which we daily see, but only his inflamed Atmosphere. I begin to be of Opinion, and I think not without Reason, that the true Magnitude of the Sun is not near what the modern Astronomers have made it; and that it may not possibly be much above two Thirds of what it appears to us; I don't mean that this Expansion of the solar Flame is any Part of that dilated Light mentioned by Sir *Isaac Newton*, and conceived to be round all light Bodies in general; but you may consider it as not much differing from it, not of an unlike Nature, only greater in Degree, and peculiar to the Sun and Stars, who are all, as has been before in a manner demonstrated to be actually Globes of Fire.

This, tho' I presume to call it at present only meer Hypothesis, will in a great measure account for the excessive Changes in the Constitution of our Air and Atmosphere, which we often find very unnatural to the Season; also be a Means perhaps of reconciling the vast Disproportion so very remarkable betwixt the Sun and the lesser Planets, and many other Circumstances in the System of no small Consequence in Astronomy: One of which Particulars you have frequently expressed a great Mistrust and Disapprobation of, as suspecting some kind of a Fallacy in the Computation; and the other is Matter of general Complaint, being by many attributed to a Change in the Direction of the Earth's Axis||; and by some, especially the Vulgar, to too near an Approximation of the Earth to some one of the celestial Bodies. But all this will very naturally be accounted for by the Levity, or expanding Quality of the Sun's circumambient

* Vide *Galilæo*.

† Betwixt the Sword and Girdle of *Orion*.

‡ Vide *Reitha*.

|| Which, through Ignorance of the true Cause, is commonly called a Shock, a Brush, or Shove.

Flame, or Atmosphere; and hence, according to its various State, being more condensed, or rare, we may have Heat or Cold in the greatest Extrem, and alternately so, in a perpetual Vicissitude.

The Truth of this Doctrine will evidently appear from the Observations of the Sun's Diameter through the Year 1660, by the indefatigable *Mouton*: And, I must own, I am not a little surprized to find that no Conclusions have been drawn from them of this Kind. I am perswaded, if you once compare those Numbers, you will be very far from thinking this an improbable Suggestion. But this Digression has led me a little too far from the *Via Lactea*, and too near home again; I must now think of returning to the Stars, and my next Endeavours must be to give you some Idea of the Number of them. Through very good Telescopes there have been discovered in many Parts of this enlightened Space, and even out of it, several thousand Stars in the Compass of one square Degree; in particular near the Sword of *Perseus*, and in the Constellations of * *Taurus* and *Orion*.

PLATE XV.

Represents the *Pleides*, a well known Knot of Stars in the Sign *Taurus*, as they appeared to me thro' a one Foot reflecting Telescope: And *Plate XVI.* is a View of the *Perfides*, another surprizing Knot of Stars in the Constellation *Perseus*, exactly as they appear through a Tube of two convex Glasses. There are also other luminous Spaces in the starry Regions, not unlike the Milky Way, which I have had no Opportunity of observing; such as the *Nebeculæ*, near the South Pole, called by the Seamen *Magellanic Clouds*; and which likewise viewed through Telescopes, present us with little *Nebulæ*, and small Stars interpersed: One of these Kind is situated between *Hydrus* and *Dorado*; and another, something less than this, betwixt *Hydrus* and the *Toucan*.

Now admitting the Breadth of the *Via Lactea* to be at a Mean but nine Degrees, and supposing only twelve hundred Stars in every square Degree, there will be nearly in the whole orbicular Area 3,888,000 Stars, and all these in a very minute Portion of the great Expanse of Heaven. What! a vast Idea of endless Beings must this produce and generate in our Minds; and when we consider them all as flaming Suns, Progenitors, and *Primum Mobiles* of a still much greater Number of peopled Worlds, what less than an Infinity can circumscribe them, less than an Eternity comprehend them,

* *Galilæa* in one cloudy Star of this Constellation, discovered no less than twenty-one, and in that of the *Præsepe* thirty-six.

PLATE. XV.



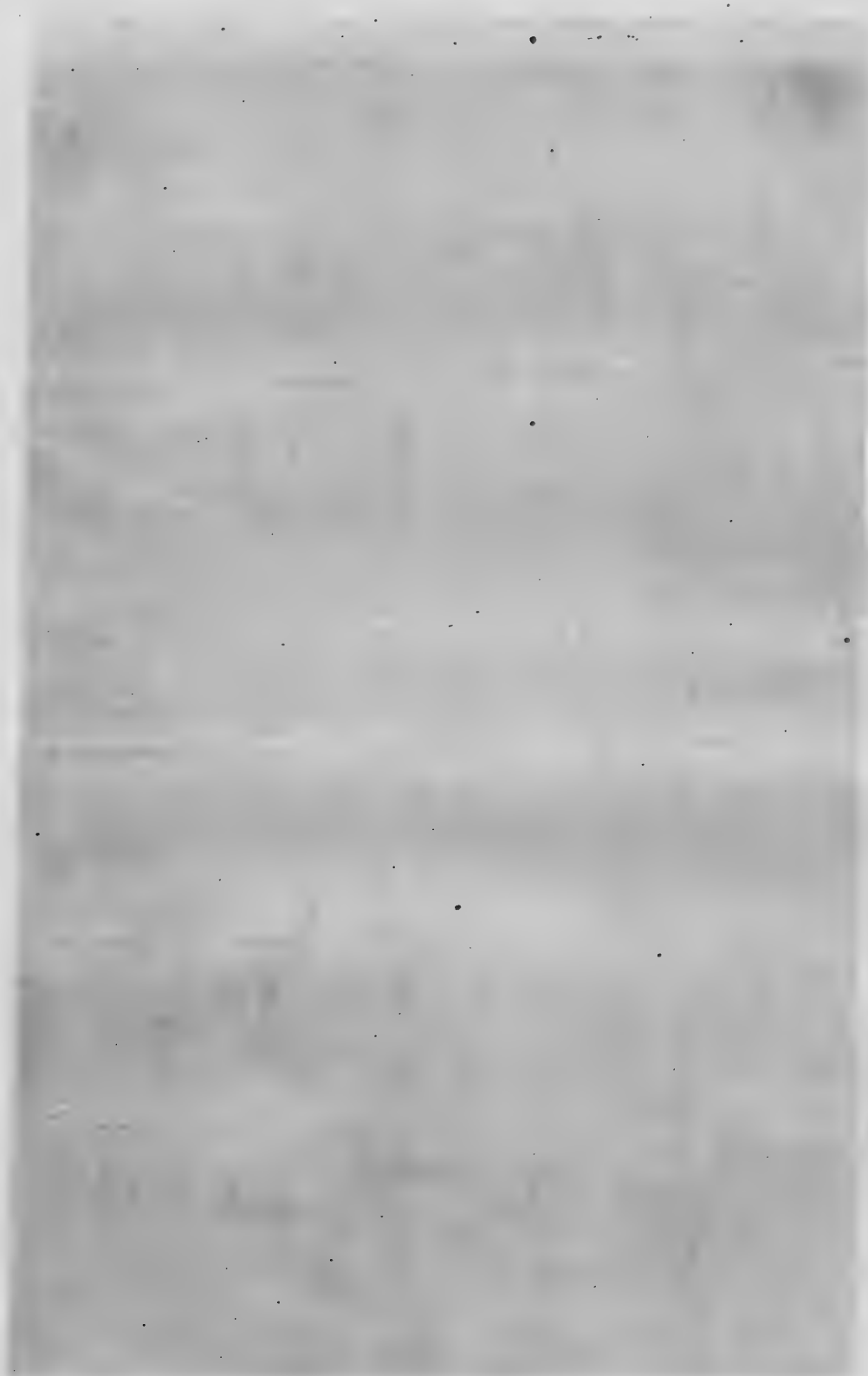
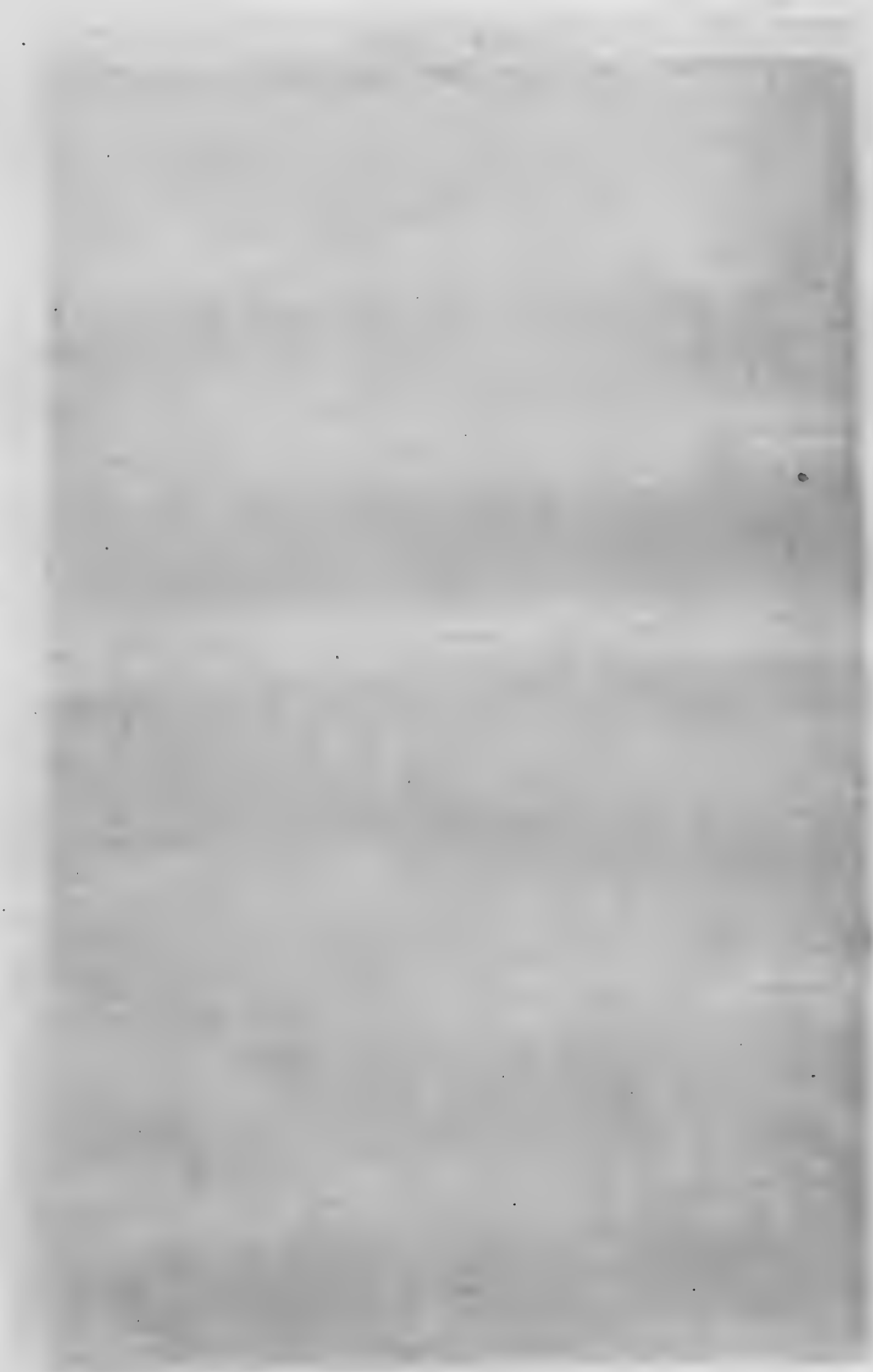


PLATE XVI.





or less than Omnipotence produce and support them, and where can our Wonder cease?

In this Place perhaps I ought not to pass over the astonishing Phenomenon of several new Stars, &c. which have frequently appeared, and soon again vanished, in the same Point of the Heavens. But as the Business of this Theory is rather to solve the general, than any particular Phænomenon, I shall only here by way of Note subjoin a Table of such as has been regularly observed, and by whom they were first discovered.

A Table of several new Stars, Nebulæ, and double Stars, &c.

<i>Nomina Stellarum.</i>	<i>Observationum.</i>
<i>Septima Pleiadum</i>	{ Lost after the burning of <i>Troy</i> , but now returned; see <i>Ricciolus</i> . Anno Dom. 945, bright as <i>Jupiter</i> ; see <i>Ricciolus</i> .
A new Star appeared in <i>Cassiopea</i> , nearly in the same Place with that of 1572.	
The new Star in <i>Cassiopea's</i> Chair.	Bright as <i>Venus</i> , from November 1572 to March 1574.
A new Star in <i>Collo Ceti</i> .	{ Of the 3d Magnitude, is said to have appear'd periodically, seven Times in six Years, i. e. every three hundred and thirteen Days: It was first observed in August 1596, for two Months, by <i>D. Fabricius</i> Observed by <i>Kepler</i> in 1600, of the third Magnitude, till the Year 1659; then gradually decreasing; in 1661 it disappeared; in 1666 it became visible again, and is yet to be seen of the sixth Magnitude.
A new Star in the Swan's Neck,	
A new Star in the Right Foot of <i>Serpentarius</i> ,	{ Bright as <i>Venus</i> from October 1604 to October 1605: see <i>Kepler</i> . Seen by <i>Simon Marius</i> and <i>Fabricius</i> , Anno 1612.
A new Star in <i>Andromeda's</i> Girdle,	
A new Star in <i>Antinous</i> ,	Seen by <i>Justus Byrgius</i> .
A new Star seen in the Whale,	{ In 1638, by <i>John Procyclus Holwarda</i> , of the third Magnitude, which disappeared periodically, every three hundred and thirty Days. Of the third Magnitude, seen by <i>Hévelius</i> in July 1670, and till August 1671, also from March 1672 to September 1672
A new Star in the Fox's Head,	
A new Star in the Swan's Neck.	{ This appear'd periodically every four hundred and four Days, and about six Months at a Time; it was seen at its brightest, September 10, 1714.

Of the Nebulæ, or Cloudy Stars.

<i>Nebulose</i> in <i>Orion's</i> Sword.	{ Small, but very luminous. Never seen in <i>England</i> .
<i>Nebulose</i> in <i>Andromeda's</i> Girdle	
<i>Nebulose</i> in the Bow of <i>Sagittarius</i> ,	{ Obscure, but with a Star in the Middle of it. Discovered by <i>Dr. Hally</i> .
<i>Nebulose</i> in <i>Centaurus</i> ,	
A <i>Nebulose</i> preceding the right Foot of <i>Antinous</i> ,	
<i>Nebulæ</i> in <i>Draco</i> <i>Herculis</i> ,	

Besides the *Nebulæ*, and new Stars, it appears from the ancient Catalogues of *Hévelius*. &c. that some of the old ones have intirely vanished; in particular, one in the left Thigh of *Aquarius*, the contiguous one preceding in the Tail of *Capricorn*; the second on the Belly of the Whale; the first of the unformed ones after the Scales of *Libra*, and several others. Many of the Stars also appear to be double, as the first Star of *Aries* and *Castor*; others triple, as one in the *Pleiades*; and the middle one in *Orion's* Sabre; and others again, quadruple, &c.

I would now willingly help you to conceive the indefinite mutual Distance of the Stars, in order to give you some small Notion of the Immenfity of Space; but as this will be a Task merely conjectural, I shall only desire you to believe it as far as your Reason will carry you, safely supported by an obvious Probability.

Perhaps it may be necessary here to acquaint you, that all the Stars are so far apparently of different Magnitudes, that no two of them are to be found in the whole Heavens exactly the same, either in Bignefs or Brightness *. The largest we have sufficient Reason to believe is the nearest to us; the next in Bignefs and Brightness more remote; and so on to the least we see, which we judge to be the most remote of all.

The first Degree, or that of the largest Magnitude, we give to SYRIUS, the second to ARCTURUS, the third to ALDEBARAN, the fourth to LYRA, the fifth to CAPELLA, the sixth to REGULUS, the seventh to RIGEL, the eighth to FOMAHAUNT, and the ninth to ANTARUS: These are all said to be of the first Class; and besides which, there are at least, within the Reach of our latest improved Opticks, nine more Denominations within the Radius of the visible Creation.

Now, by the certain Return of the Comets, which we find are all governed by the Laws of this System, and supposed to be undisturbed by any of the others, we cannot avoid concluding, if we consider them at all to the Purpose, that the nearest Stars cannot be less distant than twice the Radius of the greatest Orbit belonging to the Sun. Most Mathematicians think this a great deal too near, as it must of course make all the Systems join, as in Contact; and I think we may safely add, to separate their Spheres of Attraction, at least one Half of this Distance more, which will make in the Whole about four hundred and twenty Semi-orbits of the Earth, or 33,600,000,000 Miles. This even the ingenious Mr. *Huygens* endeavours to prove still much too little, and his Arguments are such as cannot easily be refuted. His Principle is grounded upon the known Laws of Analogy, as considered in the Proportion of light Surfaces, and is as follows. Having reduced the Sun's Disk to the Appearance of the Star SYRIUS, by the Help of a small Hole at the End of his Telescope, and comparing this Part of his Surface to the whole Disk of the Sun, he infers that the Stars Distance to that of the Sun must be as 27,664 to 1. Hence *Syrius* from us will be nearly (avoiding Units) 2,213,120,000,000 Miles: But this I take to be as much too large as the former is too little; yet, as

* A very little Knowledge in Opticks will render this indisputable, and has been in a great measure demonstrated before; 1. in the Great Dog; 2. in Bootes; 3. in the Bull; 4. in the Harp of *Apollo*; 5. in *Auriga*; 6. in the Lion; 7. in *Orion*; 8. in the Southern Fish; 9. at the End of *Erridanus*.

Mr.

Mr. *Bradley* has, with some Shew of Reason, banished all the Stars out of the Sphere of Parallax, the last is the only Method we can possibly make use of with any kind of Confidence; and Sir *Isaac Newton* endeavours to recommend it with great Force of Argument, as the only probable Means by which we can give any tolerable Guess at these immense Measurements of Space.

To moderate the Matter then if you please, allow me but to make use of a Mean betwixt the two fore-mentioned Numbers; and we may take it for granted, a Distance sufficiently exact, to suit all our Wants in the present Case, namely, to give a very tolerable Idea of the Extent of the visible Creation, which is all I propose in this Place to attempt; but I mean to be much more exact in another.

Now as the Distance from the Sun to the Earth is so small in Proportion to the Distance of the Stars from us, and from one another, we may very well consider the Sun as the Center of our Station, or Position in the general System or Frame of Nature. And as the Stars are very visible thro' good Telescopes, to the ninth or tenth Magnitude, if we multiply the primary Distance of *Syrius*, or of any other of his Class, by this Number of common intermediate Spaces, the Product will be equal to the Radius of the visible Creation to the solar Eye; which, by this Rule, you will find in capital Numbers to be * nearly 6,000,000,000,000 Miles, taking in a Star of the sixth Magnitude, and to a Star of the ninth, 9,000,000,000,000 Miles: But this Computation supposes a mean common Distance of the Stars in a sort of Syzygia, or Direction of a Right Line, which is not the real Case; for the Stars cannot be supposed to diminish in a proportional Magnitude by any mathematical *Ratio*, but by some geometrical, or rather musical one; for Instance, if the Distance of a first be 3, that of a second should be about 5, and of a proportional Third 8,333, &c. *ad infinitum*: But as their true proportional Distance is unknown, the above will be sufficient for our present Purpose; which is only to shew, without Exaggeration, the Space we now are truly sensible of.

This I have here considered more extensively, to obviate all Objections that you may make to the Probability of the general Motion of the Stars, by shewing no Difficulty can possibly arise from their apparent Proximity, Number, or irregular Distribution: Their Distances being so immensely large, no Disorder or Confusion can be supposed in any Direction of them, or Motion whatever. The greatest Distance of the Planets, which all move undisturbed round the Sun, is about three hundred and fifty-three Million of Miles: But the least Distance of one Star from another, is

* If the Distance of the Sun and Earth is found too much, which I must own I have a violent Suspicion of, these Numbers must be reduced in like Proportion.

upwards

upwards of two thousand eight hundred and thirty-two Times that Distance, or one Million of Millions of Miles: And as no sensible Disorder can be observed amongst the solar Planets, what Reason have we to suppose any can be occasioned amongst the Stars, or that a general Motion of these primary Luminaries round a common Center, should be any way irrational, or unnatural?

What an amazing Scene does this display to us! what inconceivable Vastness and Magnificence of Power does such a Frame unfold! Suns crowding upon Suns, to our weak Sense, indefinitely distant from each other; and Myriads of Myriads of Mansions, like our own, peopling Infinity, all subject to the same Creator's Will; a Universe of Worlds, all deck'd with Mountains, Lakes, and Seas, Herbs, Animals, and Rivers, Rocks, Caves, and Trees; and all the Produce of indulgent Wisdom, to cheer Infinity with endless Beings, to whom his Omnipotence may give a variegated eternal Life.

The astonishing Distance of the starry Mansions undoubtedly was design'd to answer some wise End: One Consequence is this, and probably is not without its Use: To every Planet of the same System, the same sidereal Face of Heaven appears without the least Degree of Change; and as the remotest Regions upon Earth see the same Moon and Planets, so also the Inhabitants of the most distant Planets in ours, or in any other System, see the same Forms and Order of the Stars in common with the rest. The whole Sphere of Heaven being common and unchangeable through all their various Revolutions.

Thus those (the People) in the Planet *Venus* will see the Constellation of *Orion* just as we do, and the People in the Planet *Saturn*, much farther still removed, alike will view this Constellation in all respects the same; here then, (in the System of the Sun) the Eye removed from us must only hope to find a new Earth surrounded with the same sort of Sky: But Beings in another System, behold not only a new Heaven above, but also new Earths below; and all the Frame of Nature to them puts on a new Dress, new Signs, new Seasons, and new Planets roll, and a new Sun renews the Day.

The Heathen Fables here are all erased with all the Immortality of their vain earthly Gods and Heroes; *Perseus* and *Alcides* are no more, and both the *Bears* are vanished; the *Pliads* and the *Hyads* join, and shining *Leo*, though boasting two Stars of the first Magnitude with us, there no where can be found, lost in the common undistinguished Herd. But still Astronomy will exist, and new-framed Forms may fill the varied Scene.

Perhaps you may expect that I should here give you my Conjectures of what sort of Beings may be supposed to reside in the *Ens Primum*, or *Sedes Beatorum*

Beatorum of the known Universe, whether mortal, immortal, or Creatures partaking in some Degree of the Properties of both; as such may be conceiv'd to change their Natures and States, without a total Diffolution of their Senses by Death: And farther, it may possibly be judged unpardonable in me not to point out every blessed Abode, suited to the Virtues, and all the various States an immortal Soul may be translated to; but this is a Task above the human Capacity, or is the pure Province of Religion alone; the Business of a Revelation rather than Reason to discover. Besides, it is enough for the present Purpose, to prove, that Miriads of celestial Mansions, are to be discovered within our finite View, and by a kind of ocular Revelation, which visibly extends the human Prospect, as it were, far beyond the Grave. It matters not whether a Race of Heroes fill these Worlds, or a Tribe of happy Lovers people those; whether a Peasant in the Realms of *Orion* shall ever become a Prince in the Regions of *Arcturus*, or a Patriarch in *Procion*, a Prophet in the *Precepæ*. Not to mention all the Stages human Nature may, or have been destined to in any one World, as believ'd by the ancient Philosophers, besides the final Coalition of all Beings much more naturally to be expected in the *Sedes Beatorum*.

I say, whatever our Case may be with regard to these *Queries* and Futurity, the Plan and Principles of this Theory will not be at all changed by it, since what it is chiefly founded upon may be clearly demonstrated, so clearly and incontestably, that, with the Reverend Dr. *Young*, we may justly conclude,

Devotion! Daughter of Astronomy!

and affirm with him also, That,

An indevout Astronomer is mad.

But I find what I at first propos'd will prove too long for this Letter. However, I will endeavour to reward your Patience in my next, and continue, &c.

LETTER

LETTER THE SIXTH.

*Of General Motion amongst the Stars, the Plurality of Systems, and Innumera-
bility of Worlds.*

S I R,

SINCE my last, you'll find by this, speaking in the Stile of *Kercher*, that I have been very far from home, round almost the visible Creation. I have indeed applied myself very closely to transcribe my Thoughts to you upon the old Subject the *Milky Way*, which my former Letter left imperfect. To return then to the Theory of the Stars, and that yet unreconciled Phænomenon ; let us reason a little upon the visible Order of the Stars in general, and see what Conclusions can be drawn from what every Astronomer knows of them, and cannot be disputed.

First then, that the Stars are not infinitely dispersed and distributed in a promiscuous Manner throughout all the mundane Space, without Order or Design, is evident beyond a Doubt from this vast collective Body of Light, since no such Phænomenon could possibly be produced by Chance, or exhibited without a designed Disposition of its constituent Bodies.

If any regular Order of the Stars then can be demonstrated that will naturally prove this Phænomenon to be no other than a certain Effect arising from the Observer's Situation, I think you must of course grant such a Solution at least rational, if not the Truth ; and this is what I propose by my new Theory.

To a Spectator placed in an indefinite Space, all very remote Objects appear to be equally distant from the Eye ; and if we judge of the *Via Lactea* from Phænomena only, we must of course conclude it a vast Ring of Stars, scattered promiscuously round the celestial Regions in the Direction of a perfect Circle.

But when we consider the explanick Position of many other Stars, all of the same Nature, and not less numerous, together forming the great Sphere of Heaven, we generally find ourselves quite at a Loss how to reconcile the two apparent Classes ; and I know none who have ever been successful enough to reduce them to any one general Order.

You'll

You'll say probably how shall we make this chaotic Disposition of the primary Luminaries agree with the secondary Laws, and the just Harmony observed in the third * Creation, &c.

The Work now you see is undertaken, and chiefly at your own Request, therefore I have a Right to expect you'll be very indulgent to the Author, and pass over all his Faults, and allow him free Argument in Pursuit of these important Truths, which will in the End open perhaps a much wider Field of Contemplation to us, than at first could be supposed to be intended by the *Genesis* of *Moses*.

That Description of the Beginning of Nature is not without its Beauty and Nobleness, suitable to the Dignity both of the Author and Subject. But should we even in this knowing Age of the World pretend to account for the Original of Things, as *Moses* to support his believed divine Legation, was obliged in some measure to do, we should soon be reduced to talk in the same Style, and perhaps with less Probability, than then at least appeared in his elegant Account of the Origin of the Universe, especially if we do but consider, that what he wrote, was only to the Senses of a People who had not yet learnt to make use of their Reason any other way, but from the Appearance of Things, and upon a Subject too sublime for vulgar Capacities in any Age, and had only been attempted in the deepest Learning of *Egypt*, which, he though well acquainted with, the Generality of them were totally Strangers to.

In the first Place it must be granted, that the Stars being all of the same Nature, are either all immoveable, or all fixed, that is all governed by one and the same Principle.

Now to suppose them all fixed, and dispersed in an endless Disorder thro' the infinite Expanse, which has long been the Opinion of many very able Astronomers amongst the Antients, and even now received by too many of the Moderns, implies an Inactivity in those vast and principal Bodies, so much the Reverse of what may be expected, and what we daily observe through all the rest of their Attendants, namely, their own respective Satellites, that we cannot possibly upon any rational Grounds, advance one single Argument to support so much as a Conjecture towards it, without betraying the greatest Simplicity, and next to an Affirmation reduce the whole Frame of Nature, and all corporeal Beings to a wild unmeaning Chance, arising from an unnatural Discord and Confusion.

For upon the Principles of Locality and Materiality, you having allowed me the Use of my Senses and Reason, as absolutely necessary towards conceiving any Idea of our present State, or of Futurity: Upon

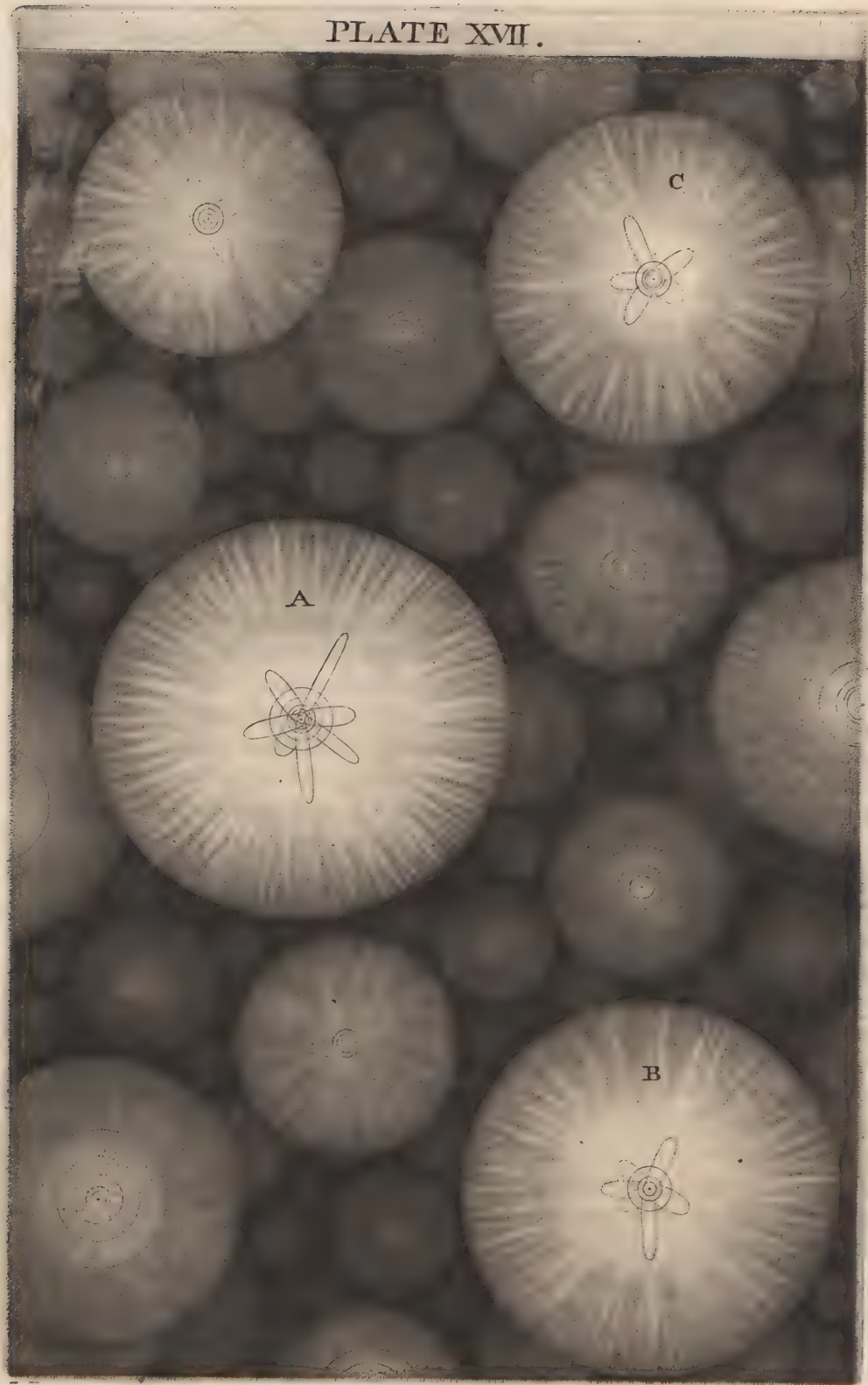
* The Moon, Satellites of *Saturn* and *Jupiter*, &c.

these Principles I say, unless our Faculties are useless, if there are no other Bodies or Beings in the Universe than what we see, and are now sensible of, we must now at the Height of this our present State, be as near Perfection as we can reasonably expect, and as such ourselves the supreme Beings of all Beings. To what End then do we form Ideas of a succeeding Life, where a more exalted State cannot be hoped for.

How absurd and impious this is I leave to your own Reason and Reflection: This is the fatal Rock upon which all weak Heads and narrow Minds are lost and split upon, consequently ought to be the most carefully avoided, not only as the Nurse of Atheism, but as the dreadful Father of Despair: "For, say they, these unhappy Wretches, to be always the same, is inconsistent with a Change; and to be less than what we are, any where hereafter, is full as difficult to conceive as to be more." Thus, unless we admit of superior Seats and much more glorious Habitations than these we are sensible of, we strike at the very Root of a fair flourishing Tree of Immortality, and must become Authors of our own Despair. I have often wonder'd how thinking Men could possibly fall into so gross an Error, as that of a Spirit's Annihilation; and I should be glad to ask one of those fruitless Students, whether, upon the Evidence of our present Being, it is not much more rational, to hope for a future, than to expect a *Ne plus ultra* upon no Evidence at all. The Affirmative is certainly much more natural to be conceiv'd than the Negative. But if Chance were the Cause, and that Chance produced all these regular and wondrous Works, 'tis to be wished at least, that Chance might do the same again; and if not Chance, of course an eternal Direction: But Chance only can effect Disorder, Discord, and Confusion; *ergo*, the visible Harmony and Beauty of the Creation declare for a Direction; and this must of Consequence, from its perfect Nature, proceed from the Wisdom and Power of an eternal Being, *God of Infinity*, the Author of all Ideas: And if this primitive Power produced us his Creatures from nothing, nothing can be wanting to revive our Frames again; and if from something, that something must remain to establish us in a future Life. But to return, how absurd it is to suppose one Part of the Creation regular, and the other irregular, or a visible circulating Order of Things, to be mixed with Disorder, and circumscribing Part of an endless Confusion, is obvious to the weakest Understanding, and consequently we may reasonably expect, that the *Via Lactea*, which is a manifest Circle amongst the Stars, conspicuous to every Eye, will prove at last the Whole to be together a vast and glorious regular Production of Beings, out of the wondrous Will or Fecundity of the eternal and infinite *one* self-sufficient Cause; and that all its Irregularities are only such as naturally arise from our excentric View: To demonstrate
which.



PLATE XVII.



which absolutely and incontestibly, we shall only want this one *Postulata* to be granted, viz. *That all the Stars are, or may be in Motion*: This, if one may be allowed to judge of the Whole by the Similitude and Government of its Parts, I am perswaded you will think a very reasonable Assumption; but that you may imbibe a good Opinion of this Assumption, and entirely come into this much better to be wished Hypothesis, I would have you consult these following Arguments.

First, it is allowed, as I have endeavoured to shew, by all modern Philosophers, that the Sun and Stars are all of the same or like Nature; consequently, that the Stars are all Suns, and that the Sun himself is a Star.

P L A T E XVII.

Represents a kind of perspective View of the visible Creation, wherein A represents the System of our Sun, B, that supposed round *Syrius*, and C, the Region about *Rigel*. The rest is a promiscuous Disposition of all the Variety of other Systems within our finite Vision, as they are supposed to be posited behind one another, in the infinite Space, and round every visible Star. That round every Star then we may justly conjecture a similar System of Bodies, governed by the same Laws and Principles with this our solar one, though to us at the Earth for very good Reasons invisible *. Secondly,

The Sun is also observed to have a Motion round his own Axis in about twenty-five Days. Now, since all the other † Planets which move in Orbits round him, and are within our Observation, are found to have a like Rotation round their Axis, may we not as reasonably imagine, that that Power which was able to give the Sun a Motion round his Axis, could and would at the same time, with adequate Ease, give him also an orbitular one? and why not, since no progressive Mutability can either take from, or disturb the boundless Property of an Infinity; and besides, seeing to imagine him at rest, is to impose such an unnatural Stagnation upon the eternal Faculty, quite repugnant to that imparable Power which we suppose stands in need of neither Sleep nor Rest?

'Tis true, the Sun may be said to be the Governor of all those Bodies round him; but how? no otherwise than he himself may be governed by a superior Agent; or a still more active Force; and methinks it is not a

* *Anaximenes* believed the Stars to be of a fiery Nature; and that there were certain terrestrial Bodies that are not seen by us, carried together round them. *Stob. Ecl. Phys. cap. 25.* *Pythagoras* affirmed, that every Star is a World, containing Earth, Air, and *Æther*.

† *Saturn, Jupiter, Mars, Venus, the Earth, Moon, and Mercury.*

little absurd to suppose he is not, since we have discovered by undoubted Observations, that the same gravitating Power is common to all ; and that the Stars themselves are subject to no other Direction than that which moves the whole Machine of Nature.

Thirdly, From many Observations of the polar Points, and the Obliquity of the Earth's Equator to the Plane of her solar Orbit compared together, the Sun is very justly suspected to have changed his sidereal Situation ; and this must either arise from a Change in the Position of the Earth's diurnal Axis, or from a Removal of the Sun himself, out of the primitive Plane of the *Orbis Magnus*. I believe you are so much of a Mathematician, as to know that if either of these Facts be allowed, the Consequence I want will follow. I shall not therefore here enter into any farther Dispute about it ; but I think it will be necessary to submit some Observations to your Consideration, that may convince you that there is a Motion somewhere to be thus discovered, and whether in the Sun, or in the Stars, or in both, I leave to your own Determination, but to assist your Imagination, I refer you to

PLATE XVIII.

The Globe S is here supposed to represent the Sun, having changed its Situation by a local Motion from A to C, and B represents the Globe of the Earth in a permanent Position, with its principal Points and Circles, respecting the primitive Plane A, B, K. Now in Consequence of the Angle of Variation, A, B, C, it evidently appears that a new ecliptic Plane, will be produced, as C, B, and also a Variation in the greatest Declination of the Sun, North and South from the Line of the *Equator* D, L. Hence, as in this Figure, the Obliquity of the Poles P, N, and G, F, will naturally decrease, and is shewn in Quantity by the Line of Aberration H, I.

Here follows a Table of the Change observed in the Obliquity of the Ecliptic by Astronomers of different Ages.

A Table of the Obliquity of the Ecliptic.

<i>Ante Christi</i>			
124	ARATO	24	00
—	HIPARCHUS	23	51 $\frac{1}{3}$
127	ERATOSTHENES	23	51 $\frac{1}{4}$

Anno

Figure 1.

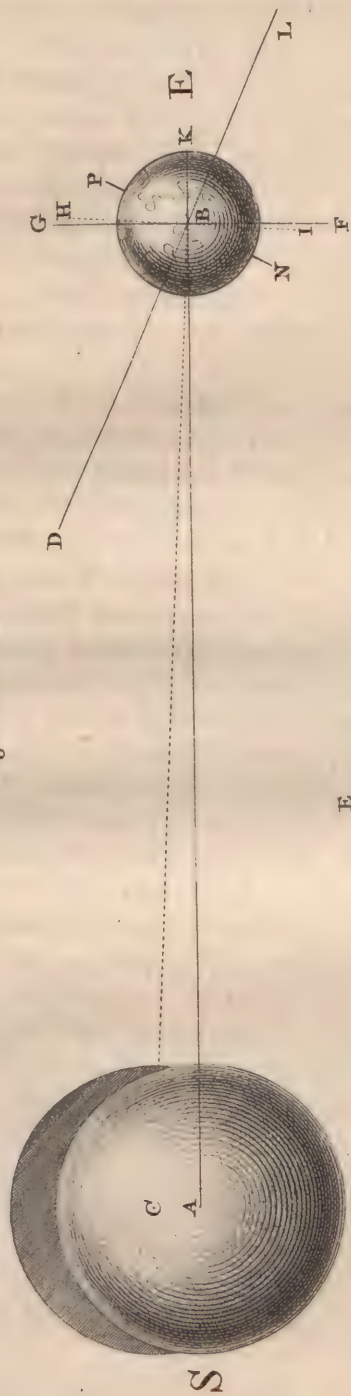


Fig. 2.

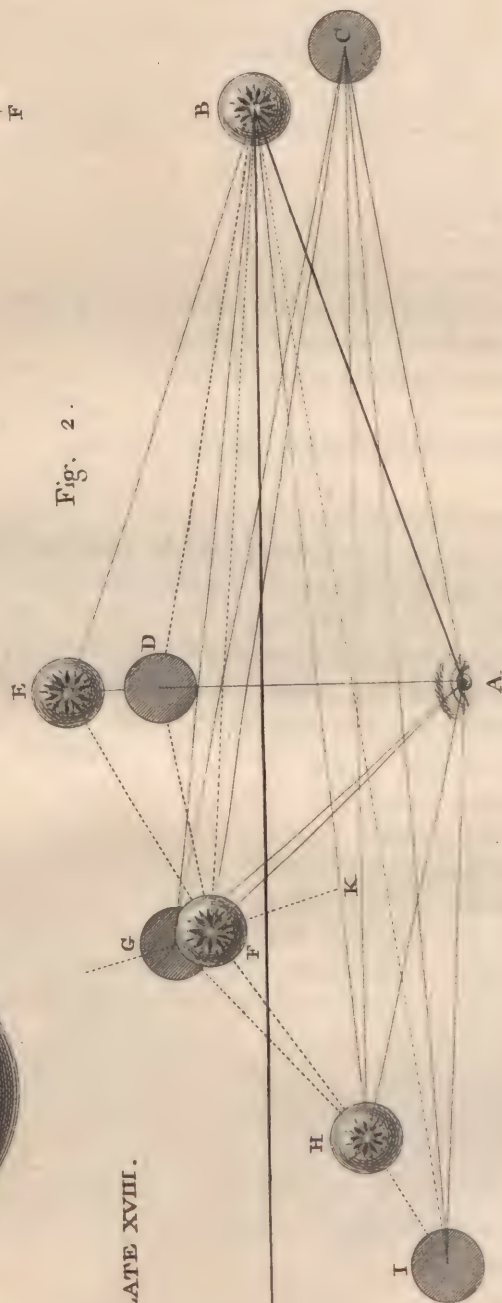


PLATE XVIII.



Anno Dom.		0	1
140	PTOLOMY	-	-
749	ABATEGNIUS	-	-
1070	AIRAHIEL	-	-
1140	ALOMEAN	-	-
1300	PROFATIOGRAD	-	-
1458	PURBACCHIO	-	-
1490	REGIOMONTAUS	-	-
1500	COPERNICUS	-	-
1592	TYCHO BRAHE	-	-
1656	CASSINI	-	-
		23	51 $\frac{1}{3}$
		23	35 $\frac{1}{4}$
		23	34
		23	33
		23	32
		23	29 $\frac{1}{4}$
		23	30
		23	28 $\frac{1}{2}$
		23	21 $\frac{1}{2}$
		23	29 $\frac{1}{2}$

Now sure, if we consider this continual Decrease of the Sun's Declination, which can proceed from no other Cause than that of his having moved out of the primitive Plane; we need make no great Difficulty thus far, to think our Conjectures not irrational.

The following is a Citation from Dr. Edmund Hally, Astronomer-Royal. See *Philosophical Transactions*, N^o. 355. p. 736.

" But while I was upon this Enquiry (*of the Obliquity of the Ecliptic*) I was surprized to find the Latitudes of three of the principal Stars in the Heavens, directly to contradict the supposed greater Obliquity of the Ecliptic, which seems confirmed by the Latitudes of most of the rest; they being set down in the old Catalogues, as if the Plane of the Earth's Orbit had changed its Situation amongst the fixed Stars, about 20' since the Time of *Hipparchus*, particularly all the Stars in *Gemini* are put down, those to the Northward of the Ecliptic, with so much less Latitude than we find, and those to the Southward, with so much more southerly Latitude; and yet the three Stars *Palilicium*, *Sirius*, and *Arcturus*, do contradict this Rule: For by it, *Palilicium*, being in the Days of *Hipparchus*, in about 10 gr. of *Taurus*, ought to be about 15' more southerly than at present, and *Sirius* being then in about 15 gr. of *Gemini*, ought to be 20' more southerly than now; yet *Ptolomy* places the first 20', and the other 22' more northerly in Latitude than we now find them: Nor are these the Errors of Transcribers, but are proved to be right by the Declination of them set down by *Ptolomy*, as observed by *Timocharis*, *Hipparchus*, and himself; which shew, that these Latitudes are the same as those Authors intended. As to *Arcturus*, he is too near the Equinoctial Colour, to argue from him concerning the Change of the Obliquity of the Ecliptic; but *Ptolomy* gives him 33' more North Latitude than

than he is now found to have; and that greater Latitude is likewise confirmed by the Declinations delivered by the abovesaid Observations: So then these three Stars are found to be above half a Degree more southerly at this Time than the Antients reckoned them. When, on the contrary, at the same time, the bright Shoulder of *Orion*, has, in *Ptolomy* almost a Degree more southerly Latitude than at present, what shall we say then? It is scarce to be believed, that the Antients could be deceived in so plain a Matter, three Observers confirming each other. Again, these Stars being the most conspicuous in Heaven, are in all Probability the nearest to the Earth; and if they have any particular Motion of their own, it is most likely to be perceived in them, which in so long a Time as eighteen hundred Years, may shew itself by the Alteration of their Places, though it be intirely imperceptible in the Space of one single Century of Years: Yet, as to *Syrius*, it may be observed, that *Tycho Brahe* makes him 2 Min. more northerly than we now find him; whereas he ought to be above as much more southerly from his Ecliptic (whose Obliquity he makes $2' \frac{1}{2}$ greater than we esteem it at at present) differing in the Whole $4' \frac{1}{2}$.

One Half of this Difference may perhaps be excused, if Refraction were not allowed in this Case by *Tycho*; yet 2 Min. in such a Star as *Syrius*, is somewhat too much for him to be mistaken in.

But a more evident Proof of this Change is drawn from the Observation of the Application of the Moon to *Palilicium*, *An. Chris.* 509. *Mar.* 11. when, in the Beginning of the Night, the Moon was seen to follow that Star very near, and seemed to have eclipsed it, ἐπέβαλλε γὰρ ὁ ἀστὴρ τῇ πᾶρα τὴν διχοτομίαν μέρει τῆς κυρτῆς περιφέρειας τοῦ πεφωτισμένου μεροῦς, i. e. *Stella appposita erat parti per quam bisecabatur limbus Lunæ illuminatus*, as *Bullialdus*, to whom we are beholden for this ancient Observation, has translated it. Now, from the undoubted Principles of Astronomy, this could never be true at *Athens*, or near it, unless the Latitude of *Palilicium* were much less than we at this Time find it*.

The Motion of *Arcturus* seems further confirmed, from the Observations of *Tycho Hevelius* and *Flamsteed*; for *Hevelius* sets down the Distance of that Star from *Lyra* 4' greater than *Tycho* had observed it seventy-two Years before him, and *Flamsteed* twenty-two Years after measured

* Vide *Bullialdi Astr. Philolaica*, p. 172.

† These are the nearest and greatest of the fixed Stars, the Motion of the others not having been observed, or being at too great a Distance, are either imperceptible, or have not been taken notice of.

the Distance betwixt the same two Stars, still 3' greater than *Hevelius* found it ; so that if *Lyra* had stood still all that while, there was an Appearance of *Arcturus*'s having gone 7' out of his Place in the Space of an hundred Years. See Dr. *Long*'s Astronomy, p. 274.

It is further to be observed, in Confirmation of the Motion of one of these Stars, that *Flamsteed* found the Distance of *Arcturus*, from the Head of *Hercules* 3' greater than it is set down by the Prince of *Hesse* ; and that his Distance from the *Lion's Tail* was a little decreased with $5' \frac{1}{2}$ less Latitude than *Tycho* had observed. Hence, to make these Observations agree, one or both of them must have moved together equal to 7'. This Change of Place, which is quite contrary to all known Causes proceeding from the Earth, must therefore be occasioned either by the Motion of the Sun, or by a particular Motion of their own ; but if, amongst themselves, they must all move, and if all be in Motion, the Sun must also move.

If these Observations, delivered down to us by very able Astronomers, be either true or near it, as great Allowances have been made for the Ignorance of the Ages in which they were taken, and the Inaccuracy of the Instruments, we may naturally conclude, that these Stars must have a Motion ; and if they move, as has been before observed, the Sun must also ; hence he cannot now be in the original Plane of the Earth's annual Direction, or at least in the same identical Place he was at first possessed of : And if so, the Stars must also have the like Motion, though in different Directions, and all may thus be governed by the same impulsive Power.

To illustrate this primitive Motion of the Stars, and at the same time to show that the Variety which appears in the Quantity of Motion can be no Objection to it,

See PLATE XVIII. Fig. 2.

Where A represents the Eye of an Observer, and B, E, F, H, various Systems, moving in different Directions thro' the mundane Space ; it is evident that the Sphere B, having moved from C, and that of E, not having appeared to move at all, there must be a sensible Change in the new Position of these two Systems to one another, and so of the rest ; and tho' the apparent Motion of H, be much more than that of F, from the Point A, yet from C, they will appear less different, and from B, they will appear nearly equal. And farther, as the Direction from H, is in the Line I, H, and that of F, in the Line K, G, those two Systems will appear to approximate, and the Magnitude of the Star in the first will be increased,

creased, and in the latter diminished. Thus, many of the Stars in the oldest Catalogues, which were said to be of the second Magnitude, are now become of the first, and several of the first are now judged to be of the second, &c.

But as this apparent Motion of the Stars at the Earth, must, from its Nature, be very small, so as scarce to be discovered in some of them in less than an Age, with any Instrument by the nicest Observer, I judge it will be extremely proper in this Place to propose some Method, by which, in process of Time, the Truth of the Theory may be ascertained. The Way I think most likely to succeed is this.

P L A T E XIX.

Is a Plan of the principal Stars that form the PLEIADES, correctly taken by a Combination of Triangles, as in the Figure, from whence it will naturally follow, all the whole Form being comprehended in much less than one Degree. That the most minute local Motion in any one of those Stars in a very few Years, will be made sensible to an Eye at the Earth. For Instance, if any of the Stars that form the Letter A, or T, within the Term of ten or twenty Years, be found in the least to deviate from the Lines of their present Position and Direction, it will be evident beyond a Contradiction, that they have a Motion amongst themselves, and since at such a Distance they cannot possibly be affected by the Earth, it must be a Motion of their own; and thus if any one can be proved, to change its Situation, with regard to the rest, we can have no new Difficulty in concluding that they all may do the same.

Thus if any of the regular Triangles MBZ, ZPH, AZM, TAG, or NOI, &c. in due Time be carefully noted, we may venture to say with great Safety, that the thousandth Part of a Degree will be plainly discovered.

P L A T E XX.

Is a true Plan and Combination of the principal Stars that form the PERSEDES, in which other Observations may be made in a different Part of the Heavens, and perhaps with an Opportunity of being still more exact, the Areas of these Triangles, particularly that of ΘIK , and those of ρ and δ , being much less than the former, where the least Alteration possible must render them sensibly distorted. But here it must be considered, that the real Motion of the Stars, as well as their apparent, may be, and in
all

1

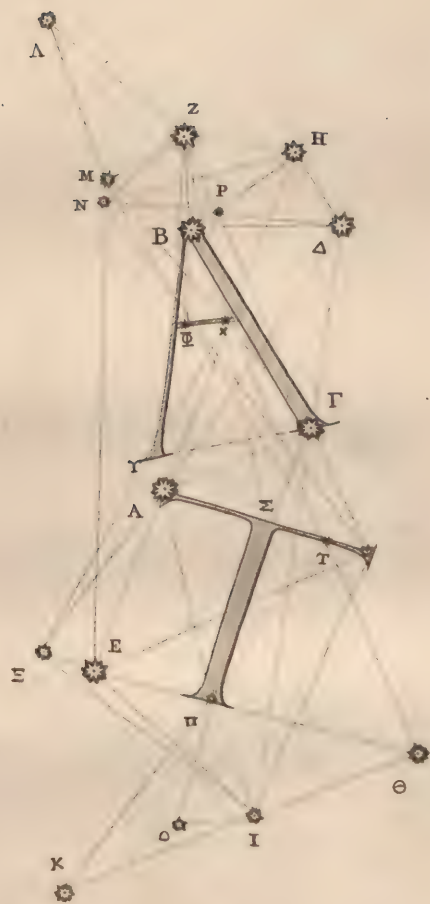


PLATE. XX.



all Likelihood, is extreamly slow, for the most minute, visible, local Motion, will answer all the Purposes we know in Nature, and the greatest seems to be that of the projectile, or centrifugal Force, which not only preserves them in their Orbits, but prevents them from rushing all together; by the common universal Law of Gravity, which otherwise, as a finite Distribution of either regular or irregular Bodies, they must at length do by Necessity.

I must now inform you, that the above Observations were compleated in the AUTUMN SEASON, 1747, and were taken by myself; the Letters A, T, in *Plate XIX*, and the W in the XXth, as you may see, having a very near Resemblance, or Similitude, to the Order these Stars are found to be in, together with the *Greek Alphabet*, I judged necessary, by way of *Asterism* and *Nomenclatura*, in case such should be wanted, as *Data* in future Discoveries.

I come now to the principal Point in Question, which is to find a regular Disposition of the Stars amongst themselves, which will naturally solve both their general and particular Phænomena, especially the *Nebula* and *Milky Way*.

I am now, &c.



LETTER THE SEVENTH.

*The Hypothesis, or Theory, fully explained and demonstrated, proving the
fidereal Creation to be finite.*

S I R,

I KNOW you are an Enemy to all Sorts of Schemes where they are not absolutely necessary, and may possibly be avoided; and for that Reason I have purposely omitted many geometrical Figures, and other Representations in this Work, which might have been inserted and in some Places, especially here I might have introduced Diagrams, perhaps more explicit than Words; but as you have frequently observed, they are only of Use to the few Learned, and contribute more to the taking away the little Ideas and Knowledge the more ignorant Many may be endued with, by a prejudicial Impression of imperfect Images, rather than the adding any new Light to their Understanding, I have purposely avoided, as much as possible, both here and every where, all such complex Diagrams as might be in Danger of betraying any the least such conscious Diffidence in you, arising from the Want of a proper *Precognita* in the Sciences.

This Imperfection, much to be lamented, as greatly to the Disadvantage of all mathematical Reasoning, I would willingly always prevent, in my Readers, and to chuse in my Friend; I shall therefore content myself with referring you to a few orbicular Figures, concave and convex, as may best suggest to your Fancy the simplest Way, a just Idea of the Hypothesis I have fram'd, and naturally enough I hope, render my Theory so intelligible, as to help you sufficiently to conceive the Solution aimed at, of the important Problem I have attempted.

As I have said before, we cannot long observe the beauteous Parts of the visible Creation, not only those of this World on which we live, but also the Myriads of bright Bodies round us, with any Attention, without being convinced, that a Power supreme, and of a Nature unknown to us, presides in, and governs it.

The

The Course and Frame of this vast Bulk, display
A Reason and fix'd Law, which all obey.

SHER. MANILIUS.

And notwithstanding the many wonderful Productions of Nature in this our known Habitation, yet the Earth, when compared with other Bodies of our own System, seems far from being the most considerable in it; and it appears not only very possible, but highly probable, from what has been said, and from what we can farther demonstrate, that there is as great a Multiplicity of Worlds, variously dispersed in different Parts of the Universe, as there are variegated Objects in this we live upon. Now, as we have no Reason to suppose, that the Nature of our Sun is different from that of the rest of the Stars; and since we can no way prove him superior even to the least of those surprising Bodies, how can we, with any Shew of Reason, imagine him to be the general Center of the whole, *i. e.* of the visible Creation, and seated in the Center of the mundane Space? This, in my humble Opinion, is too weak even for Conjecture, their apparent Distribution, and * irregular Order argue so much against it.

The Earth indeed has long possessed the chief Seat of our System, and peaceably reigned there, as in the Center of the Universe for many Ages past; but it was human Ignorance, and not divine Wisdom, that placed it there; some few indeed from the Beginning have disputed its Right to it, as judging it no way worthy of such high Eminence. Time at length has discovered the Truth to every body, and now it is justly displaced by the united Consent of all its Inhabitants, and instead of being thought the most majestick of all Nature's lower Works, now rather disgraces the Creation, so much it is reduced in its present State from what it had Reason to expect in the former.

Now it is no longer the only terrestrial Globe in the Universe, but is proved to be one of the least Planets of the solar System, and surprizingly inferior to some of its Fellow Worlds. The Sun, or rather the System, has almost as long usurped the Center of Infinity, with as little Pretence to such Pre-heminence; but now, Thanks to the Sciences, the Scene begins to open to us on all Sides, and Truths scarce to have been dreamt of, before Persons of Observation had proved them possible, invades our Senses

* See the Zodaical Constellations, you'll find that in some Signs there are several Stars of the first, second, and third Magnitude, and in many others none of these at all.

with a Subject too deep for the human Understanding, and where our very Reason is lost in infinite Wonders. How ought this to humble every Mind susceptible of Reason!

In this Place, I believe, you will pardon a Digression; which, in Answer to Part of your last Letter, I judge will not be very impertinent, tho' perhaps just here I cannot so well justify it.

Your late Conversation with our Friend Mr. * * *, I am perswaded, must have been very entertaining; but I cannot help thinking his Reflections upon the Wonders of Nature and the Wisdom of Providence, though I must allow them all to be very just and curious, instead of elevating the Mind to the Pitch he would have it, rather as considered above, depress it below the proper, nay I might say necessary, Standard of human Ideas.

This, probably, you'll say is an odd Turn, and may want some Explanation, since every Object in the Chain of Nature, must of Force be granted, a Subject worthy of our Speculations, being all together made, as in the Maximum of Wisdom: But what I mean is this, since nothing is more natural for Beings in every State in search after their own Advantages, and the Enlargement of their Ideas to look upward, sure it may be presumed, that Time may be mispent, if not lost in inspecting too narrowly Things so little beneficial in States below us; as Mr. *Pope* says,

Why has not Man a microscopic Eye?
For this plain Reason, Man is not a Fly.
Say what the Use, were finer Opticks given,
To inspect a Mite, not comprehend the Heav'n.

Essay on Man.

Amusement alone can never be supposed to be the sole End of human Life, where even true Happiness is a Thing we rather taste than enjoy. The Mind we find capable of much more rational Pleasure than can possibly fall within the Reach of human Power, either to promise or procure it; but then this very Defect in our present State of Existence affords us no less than a moral Assurance, that some where in a future, we may, if we please, be entitled to the very *Plenum* of all Enjoyments.

The peculiar Business then of the human Mind naturally precedes its Amusements, as evidently ordained to soar above all the inferior Beings of this World; and however our Natures may, thro' Indolence, or thro' Ignorance, degenerate, that of the Man can never be supposed to sink into the Mole.

The properest Way then sure for Men to preserve their Pre-heminence over the Brute Creation, is to make use of that Reason and Reflection, which

which so manifestly distinguishes their natural Superiority. A right Application of which, must of course then direct us to a forward, rather than a backward Search in the vast visible Chain of our Existence, which clearly connects all Beings and States as under the Direction of one supreme Agent.

This is all I would have understood by the foregoing Position, which, in one Word, implies no more than that the sublime Philosophy ought in all Reason to be preferred to the Minute; but I hope you will not infer from this my seeming Partiality for the celestial Sciences, that I mean to insinuate, that the Study of terrestrial Physicks is not a rational Amusement.

Mr. ***, you say, seems to lament the Taste of Mankind in general much in the same Degree as you do his I readily grant you; a Man who can talk so well upon an Ant, might make a more entertaining Discourse upon the Eagle; but I beg his Pardon, and though we are all too ready, and most apt to condemn all such Pleasures as vain or trifling, which we have no Share in, or Taste for ourselves; yet I don't think it follows, that those ingenious Labours of his are useless. The Pleasures arising from natural Philosophy are all undoubtedly great ones, whether we consider Nature in her highest, or in her lowest Capacity; the Beauties of the Creation are every Day varied to us below, as much they are every Night above, and in both Cases, through every Object, the Creator shines so manifest, that we may justly consider him every where smiling full in the Face of all his Creatures, commanding as it were an awful Reverence, and Respect, due not only to his Omnipotency, but also to his infinite Goodness and endless Indulgencies. This is the only Return our Gratitude can make for all those Blessings he daily bestows upon us, and to this great Author of her Laws, Nature herself cries aloud through Myriads of various Objects, and after her own expressive and peculiar Manner, seems to command us with an attractive Grace, to observe her Sovereign, and admire his Wisdom. The Majesty, Power, and Dominion of God is best displayed in the external Direction of Things, his Wisdom and visible Agency in the internal: Hence, by proper Objects, selected from both, attended with just Reflections, we may certainly raise our Ideas almost to the Pitch of Immortals; but how far the human Imagination may possibly go, or how much Minds like ours may be improved, is a Question not easily determined; but as natural Knowledge evidently increases daily, and astronomical Enquiries are the most capable of opening our Minds, and enlarging our Conception, of consequence they must be most worthy our Attention of all other Studies. But of this I have said enough, and think it is now more than Time to attempt the remaining Part of my Theory.

When

When we reflect upon the various Aspects, and perpetual Changes of the Planets, both with regard to their *heliocentric and geocentric Motion, we may readily imagine, that nothing but a like eccentric Position of the Stars could any way produce such an apparently promiscuous Difference in such otherwise regular Bodies. And that in like manner, as the Planets would, if viewed from the Sun, there may be one Place in the Universe to which their Order and primary Motions must appear most regular and most beautiful. Such a Point, I may presume, is not unnatural to be supposed, altho' hitherto we have not been able to produce any absolute Proof of it. See *Plate XXV*.

This is the great Order of Nature, which I shall now endeavour to prove, and thereby solve the Phænomena of the *Via Lactea*; and in order thereto, I want nothing to be granted but what may easily be allowed, namely, that the *Milky Way* is formed of an infinite Number of small Stars.

Let us imagine a vast infinite Gulph, or Medium, every Way extended like a Plane, and inclosed between two Surfaces, nearly even on both Sides, but of such a Depth or Thickness as to occupy a Space equal to the double Radius, or Diameter of the visible Creation, that is to take in one of the smallest Stars each Way, from the middle Station, perpendicular to the Plane's Direction, and, as near as possible, according to our Idea of their true Distance.

But to bring this Image a little lower, and as near as possible level to every Capacity, I mean such as cannot conceive this kind of continued Zodiack, let us suppose the whole Frame of Nature in the Form of an artificial Horizon of a Globe, I don't mean to affirm that it really is so in Fact, but only state the Question thus, to help your Imagination to conceive more aptly what I would explain*. *Plate XXIII*. will then represent a just Section of it. Now in this Space let us imagine all the Stars scattered promiscuously, but at such an adjusted Distance from one another, as to fill up the whole Medium with a kind of regular Irregularity of Objects. And next let us consider what the Consequence would be to an Eye situated near the Center Point, or any where about the middle Plane, as at the Point A. Is it not, think you, very evident, that the Stars would there appear promiscuously dispersed on each Side, and more and more inclining to Disorder, as the Observer would advance his Station towards either Surface, and nearer to B or C, but in the Direction of the general Plane towards H or D, by the continual Approximation of the visual Rays, crowding together as at H, betwixt the Limits D and G, they must in-

* Not to mention their several Conjunctions and Apulces to fixed Stars, &c. see the State of the Heavens in 1662, December the first, when all the known Planets were in one Sign of the Zodiac, viz. *Sagittarius*.

PLATE .XXI.

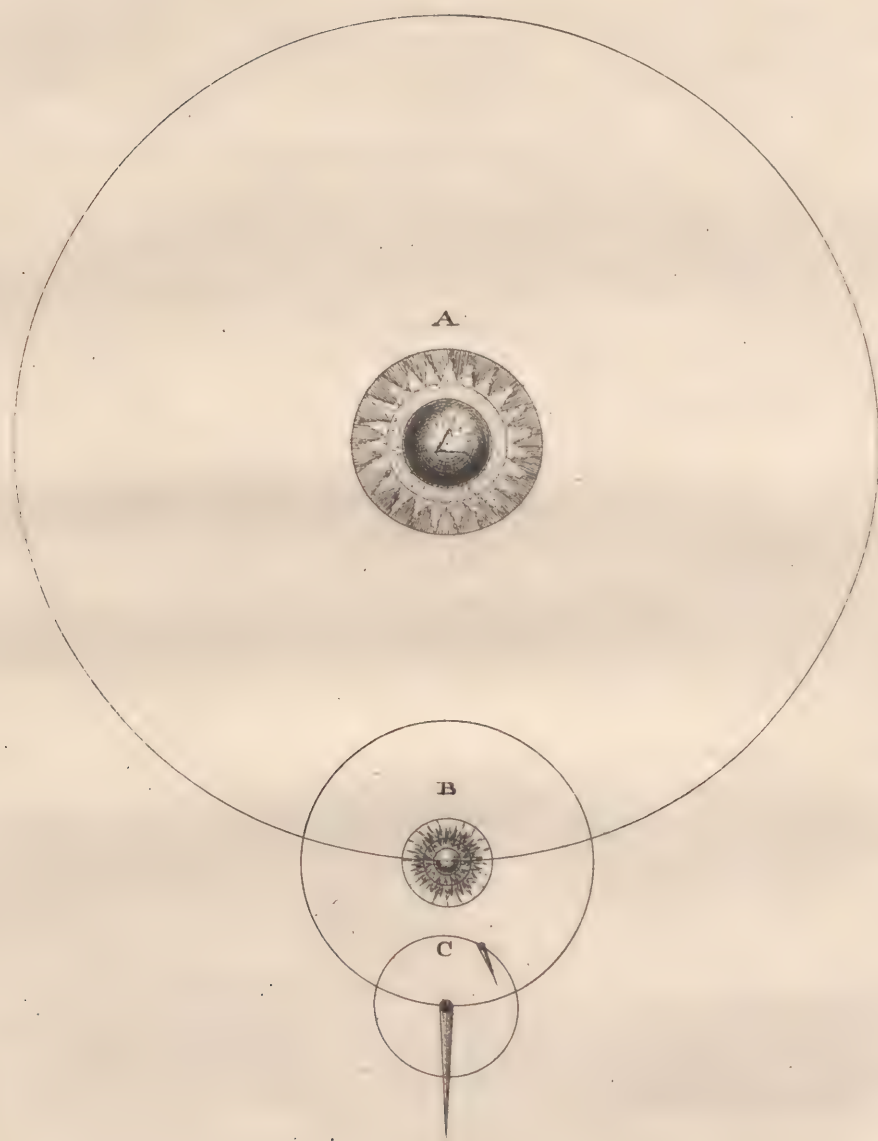
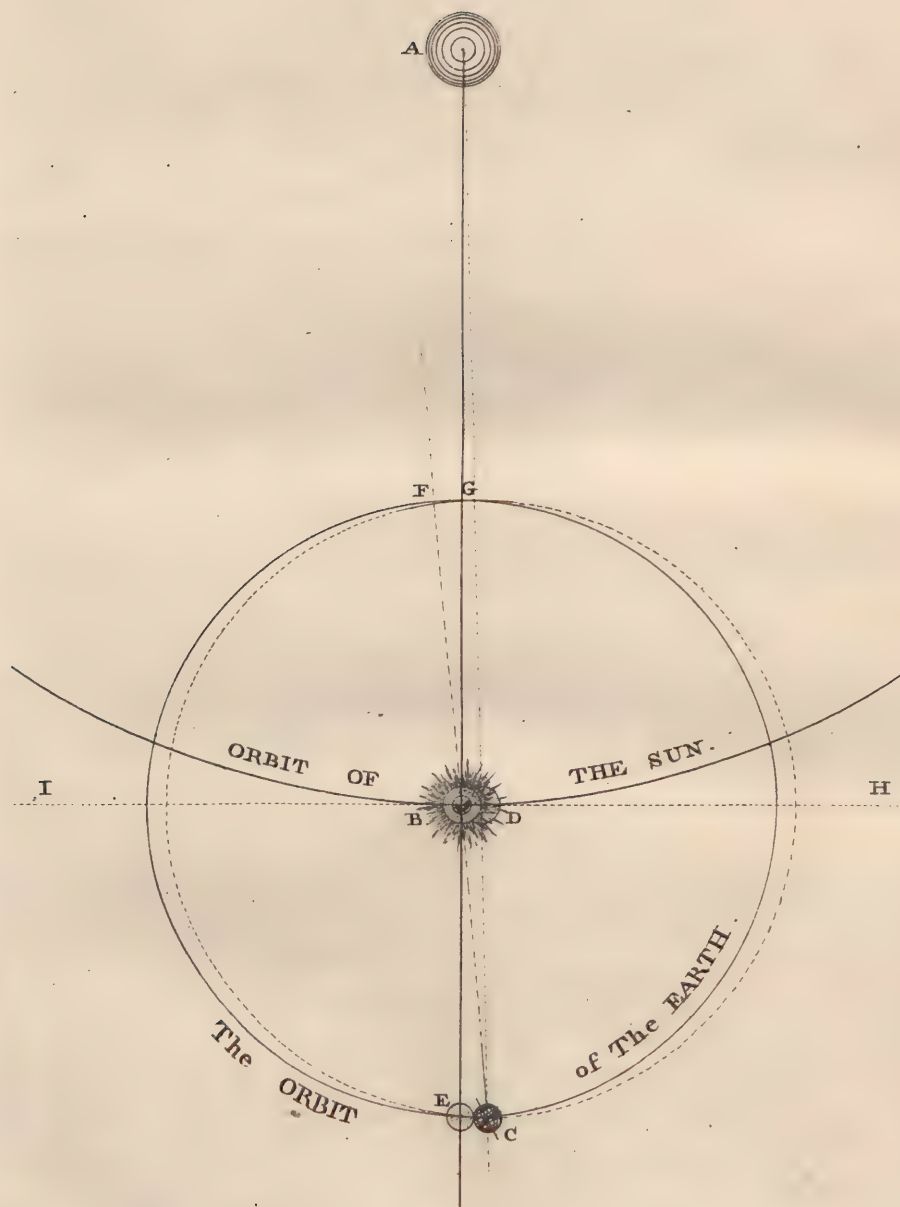


PLATE XXII.



fallibly terminate in the utmost Confusion. If your Opticks fails you before you arrive at these external Regions, only imagine how infinitely greater the Number of Stars would be in those remote Parts, arising thus from their continual crowding behind one another, as all other Objects do towards the Horizon Point of their Perspective, which ends but with Infinity: Thus, all their Rays at last so near uniting, must meeting in the Eye appear, as almost, in Contact, and form a perfect Zone of Light; this I take to be the real Cause, and the true Nature of our *Milky Way*, and all the Irregularity we observe in it at the Earth, I judge to be intirely owing to our Sun's Position in this great Firmament, and may easily be solved by his Excentricity, and the Diversity of Motion that may naturally be conceived amongst the Stars themselves, which may here and there, in different Parts of the Heavens, occasion a cloudy Knot of Stars, as perhaps at E.

But now to apply this Hypothesis to our present Purpose, and reconcile it to our Ideas of a circular Creation, and the known Laws of orbicular Motion, so as to make the Beauty and Harmony of the Whole consistent with the visible Order of its Parts, our Reason must now have recourse to the Analogy of Things. It being once agreed, that the Stars are in Motion, which, as I have endeavoured in my last Letter to shew is not far from an undeniable Truth, we must next consider in what Manner they move. First then, to suppose them to move in right Lines, you know is contrary to all the Laws and Principles we at present know of; and since there are but two Ways that they can possibly move in any natural Order, that is, either in right Lines, or in Curves, this being one, it must of course be the other, *i. e.* in an Orbit; and consequently, were we able to view them from their middle Position, as from the Eye seated in the Center of *Plate XXV.* we might expect to find them separately moving in all manner of Directions round a general Center, such as is there represented. It only now remains to shew how a Number of Stars, so disposed in a circular Manner round any given Center, may solve the Phænomena before us. There are but two Ways possible to be proposed by which it can be done, and one of which I think is highly probable; but which of the two will meet your Approbation, I shall not venture to determine, only here inclosed I intend to send you both. The first is in the Manner I have above described, *i. e.* all moving the same Way, and not much deviating from the same Plane, as the Planets in their heliocentric Motion do round the solar Body. In this Case the primary, secondary, and tertiary constituent Orbits, &c. framing the Hypotheses, are represented in *Plate XXII*, and the Consequence of such a Theory arising from such an universal Law of Motion

tion in *Plate XXIII.* where B, D denotes the local Motion of the Sun in the true *Orbis Magnus*, and E, C that of the Earth in her proper secondary Orbit, which of course is supposed, as is shewn in the Figure to change its sidereal Positions, in the same Manner as the Moon does round the Earth, and consequently will occasion a kind of Procession, or annual Variation in the Place of the Sun, not unlike that of the Equinoxes, or Motion of all the Stars together, from West to East round the Ecliptic Poles, and probably may in some Degree be the Occasion of it. This Angle is represented, but much magnified, by the Lines F, C, G, and the Unnaturalness, or Absurdity of a right Line Motion of the Sun by the Line I, H.

The second Method of solving this Phænomena, is by a spherical Order of the Stars, all moving with different Direction round one common Center, as the Planets and Comets together do round the Sun, but in a kind of Shell, or concave Orb. The former is easily conceived, from what has been already said, and the latter is as easy to be understood, if you have any Idea of the Segment of a Globe, which the adjacent Figures, will, I hope, assist you to. The Doctrine of these Motions will perhaps be made very obvious to you, by inspecting the following Plates.

PLATE XXIV.

Is a Representation of the Convexity, if I may call it so, of the intire Creation, as a universal Coalition of all the Stars consphered round one general Center, and as all governed by one and the same Law.

PLATE XXV.

Is a central Section of the same, with the Eye of Providence seated in the Center, as in the virtual Agent of Creation.

PLATE XXVI.

Represents a Creation of a double Construction, where a superior Order of Bodies C, may be imagined to be circumscribed by the former one A, as possessing a more eminent Seat, and nearer the supream Presence, and consequently of a more perfect Nature. Lastly,

PLATE XXVII.

Represents such a Section, and Segments of the same, as I hope will give you a perfect Idea of what I mean by such a Theory.

Fig. 1. is a corresponding Section of the Part at A, in *Fig. 2.* whose versed Sine is equal to half the Thickness of the starry Vortice A C, or B A. Now I say, by supposing the Thickness of this Shell, 1. you may imagine the middle Semi-Chord A D, or A E, to be nearly 6; and consequently,

PLATE XXI.

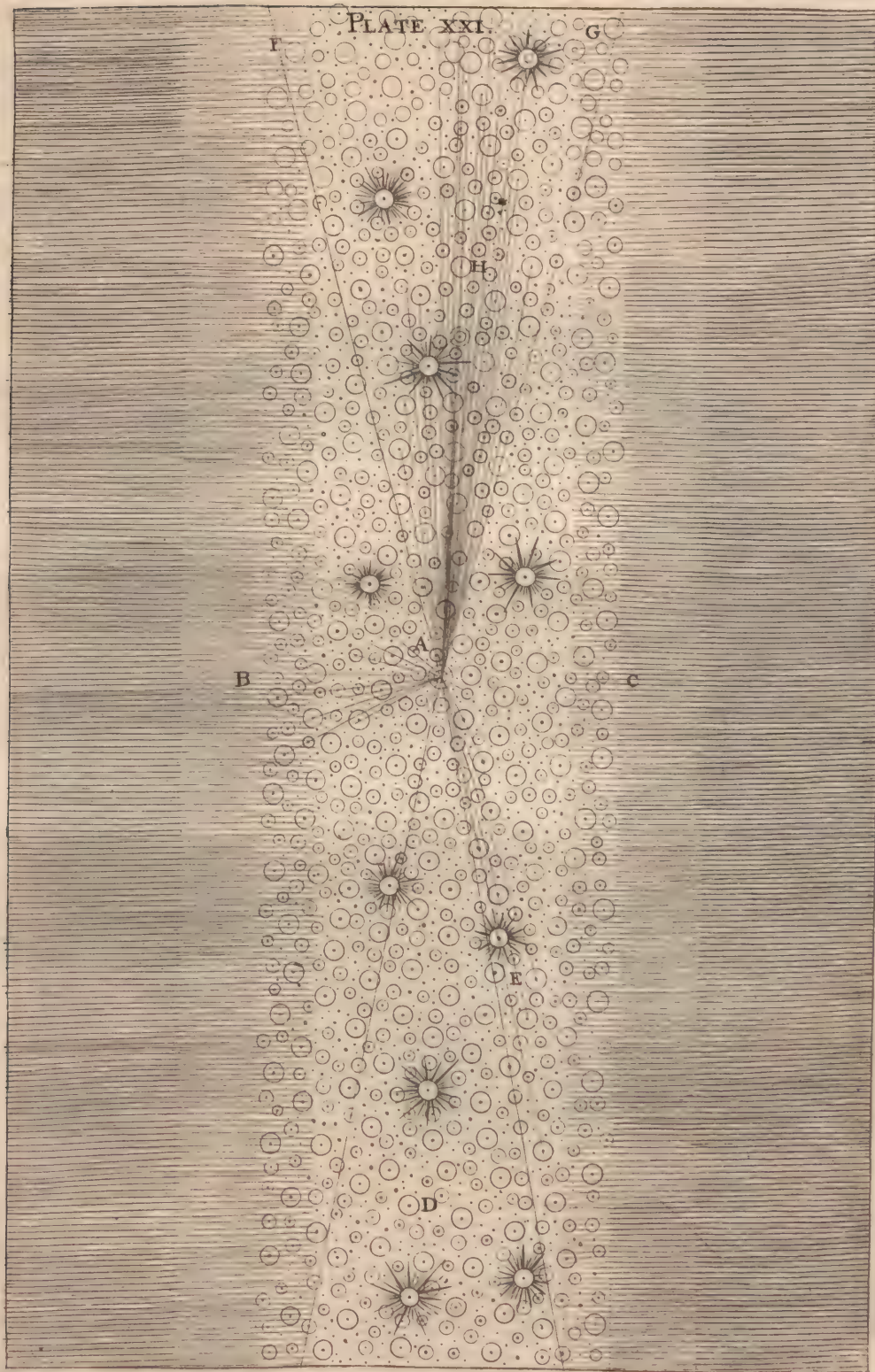




PLATE XXIV.

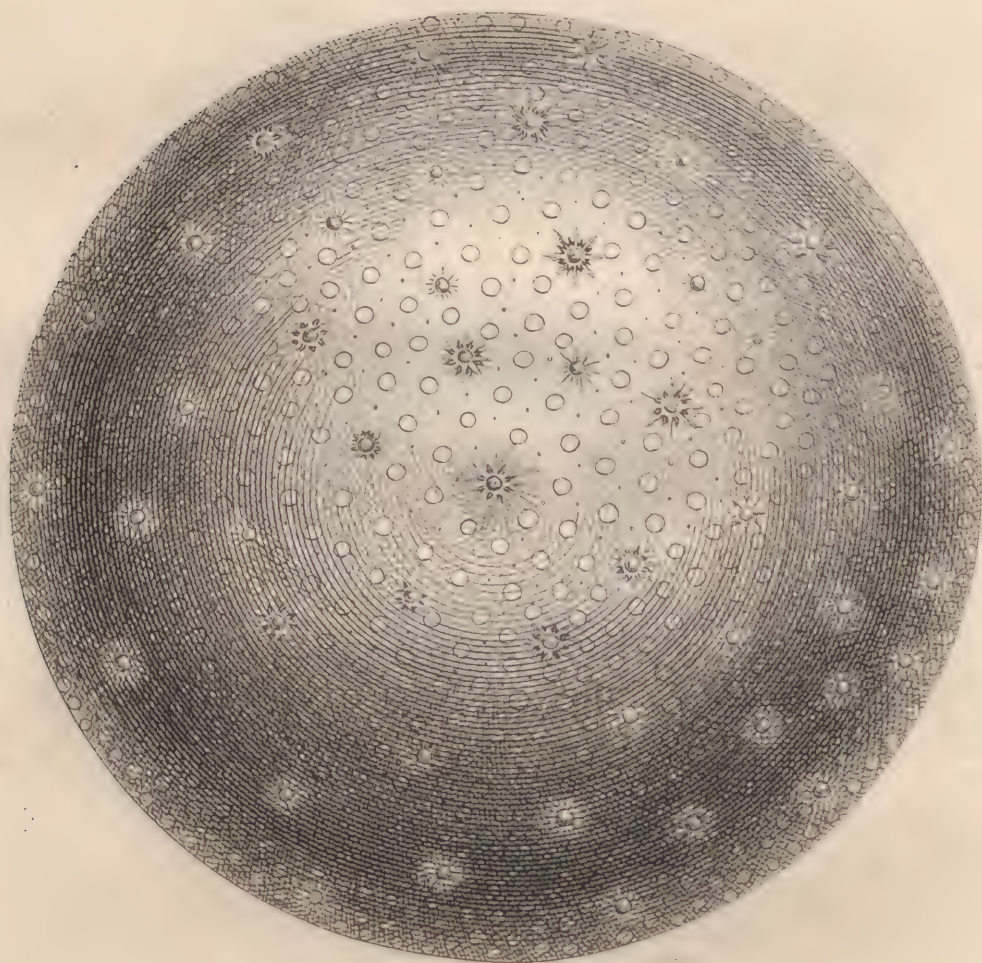




PLATE XXV.

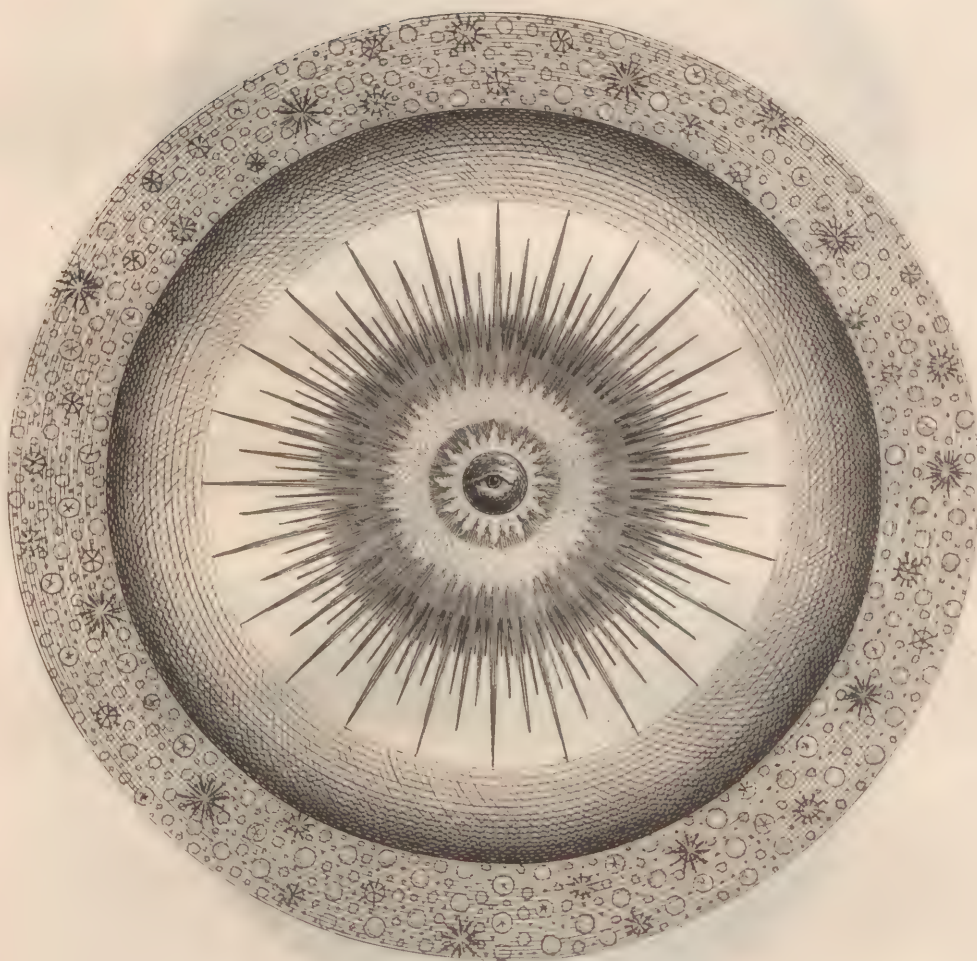


PLATE XXVI.

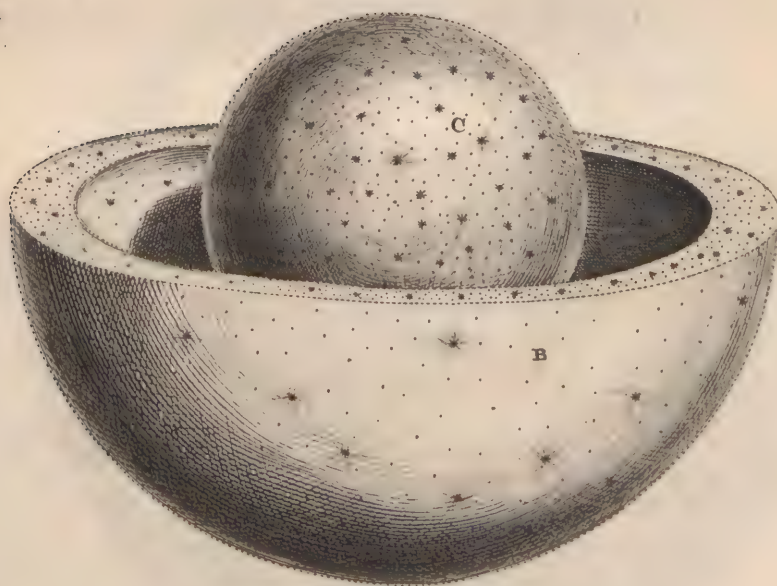
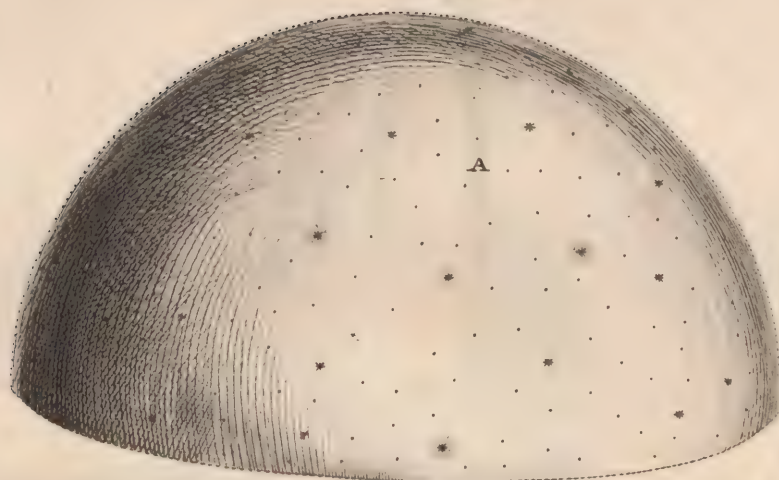


PLATE XXVII.

Figure . 1 .

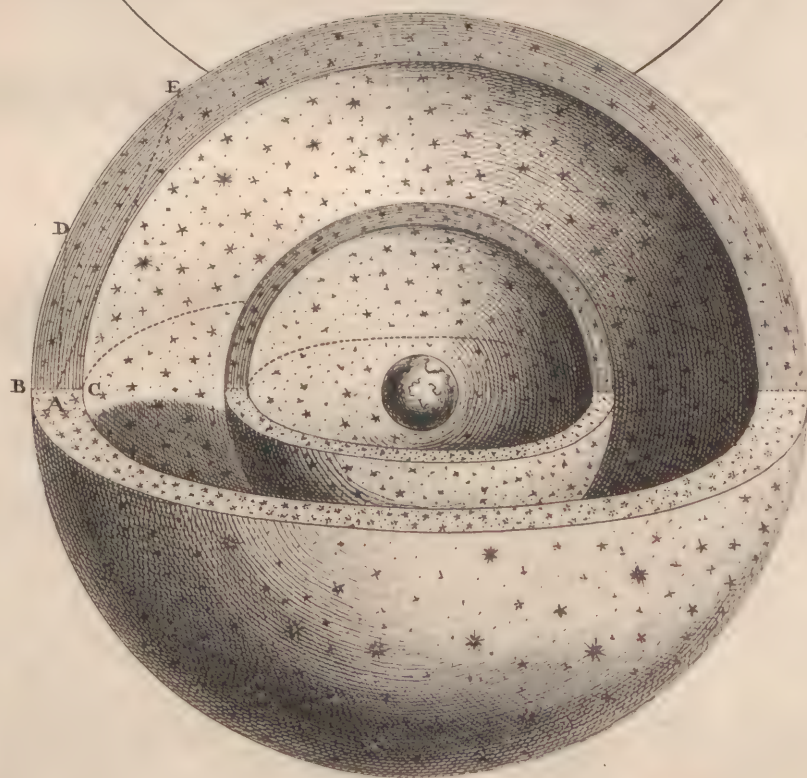
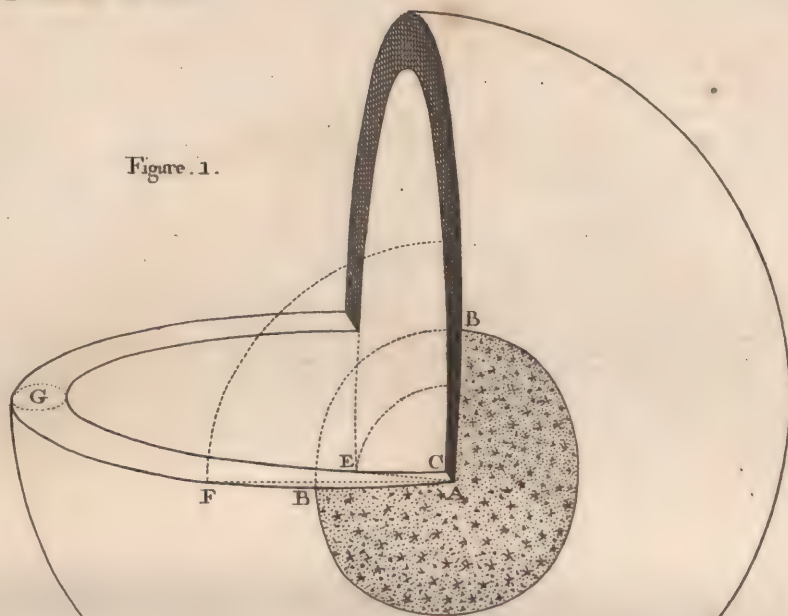


Fig. 2 .





PLATE XXVIII.

Figure I.

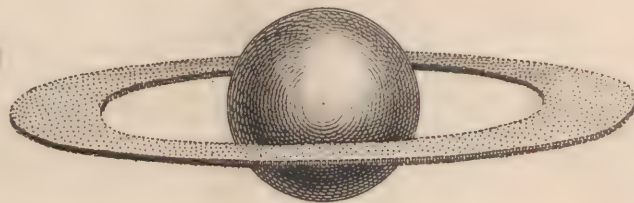


Fig. II.

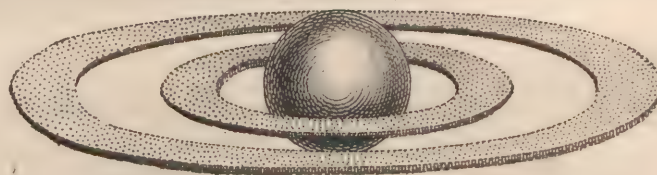


Fig. III.

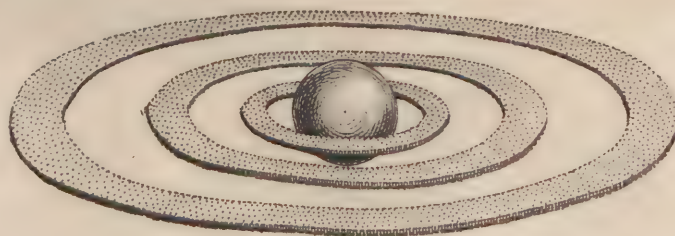


PLATE . XXIX .

Figure I .

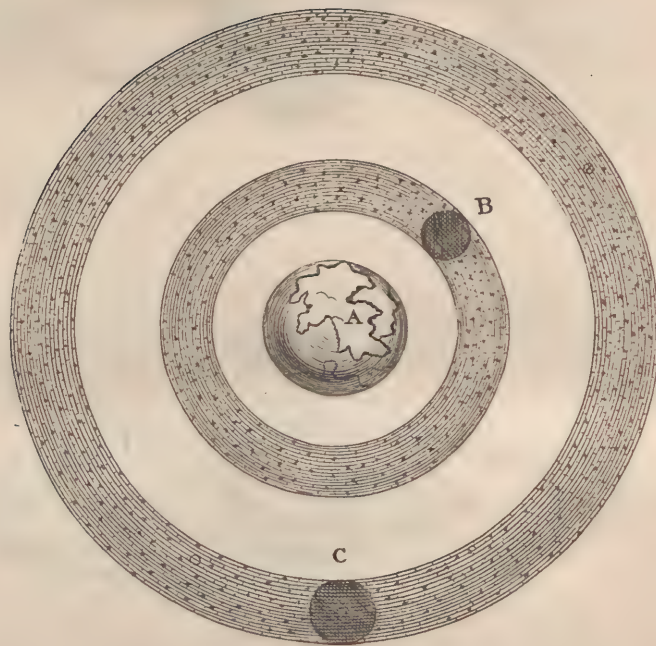
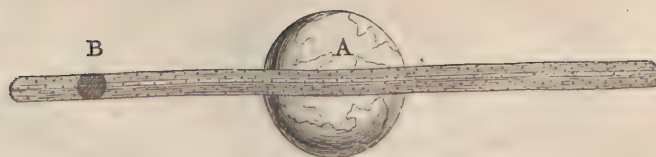


Fig. II .



thus in a like regular Distribution of the Stars, there must of course be at least three Times as many to be seen in this Direction of the Sine, or Semi-chord A E, itself, than in that of the semi-versed Sine A C, or where near the Direction of the Radius of the Space G. Q. E. D.

But we are not confined by this Theory to this Form only, there may be various Systems of Stars, as well as of Planets, and differing probably as much in their Order and Distribution as the Zones of *Jupiter* do from the Rings of *Saturn*, it is not at all necessary, that every collective Body of Stars should move in the same Direction, or after the same Model of Motion, but may as reasonably be supposed as much to vary, as we find our Planets and Comets do.

Hence we may imagine some Creations of Stars may move in the Direction of perfect Spheres, all variously inclined, direct and retrograde; others again, as the primary Planets do, in a general Zone or Zodiack, or more properly in the Manner of *Saturn's* Rings, nay, perhaps Ring within Ring, to a third or fourth Order, as shewn in *Plate XXVIII.* nothing being more evident, than that if all the Stars we see moved in one vast Ring, like those of *Saturn*, round any central Body, or Point, the general Phænomena of our Stars would be solved by it; see *Plate XXIX. Fig. 1.* and 2. the one representing a full Plane of these Motions, the other a Profile of them, and a visible Creation at B and C, the central Body A, being supposed as *incognitum*, without the finite View; not only the Phænomena of the *Milky Way* may be thus accounted for, but also all the cloudy Spots, and irregular Distribution of them; and I cannot help being of Opinion, that could we view *Saturn* thro' a Telescope capable of it, we should find his Rings noother than an infinite Number of lesser Planets, inferior to those we call his Satellites: What inclines me to believe it, is this, this Ring, or Collection of small Bodies, appears to be sometimes very excentric, that is, more distant from *Saturn's* Body on one Side than on the other, and as visibly leaving a larger Space between the Body and the Ring; which would hardly be the Case, if the Ring, or Rings, were connected, or solid, since we have good Reason to suppose, it would be equally attracted on all Sides by the Body of *Saturn*, and by that means preserve every where an equal Distance from him; but if they are really little Planets, it is clearly demonstrable from our own in like Cases, that there may be frequently more of them on one Side, than on the other, and but very rarely, if ever, an equal Distribution of them all round the *Saturnian* Globe.

How much a Confirmation of this is to be wished, your own Curiosity may make you judge, and here I leave it for the Opticians to determine. I shall content myself with observing that Nature never leaves us without

K

a suffi-

a sufficient Guide to conduct us through all the necessary Paths of Knowledge; and it is far from absurd to suppose Providence may have every where throughout the whole Universe, interspersed Modules of every Creation, as our Divines tell us, Man is the Image of God himself.

Thus, Sir, you have had my full Opinion, without the least Reserve, concerning the visible Creation, considered as Part of the finite Universe; how far I have succeeded in my designed Solution of the *Via Lactea*, upon which the Theory of the Whole is formed, is a Thing will hardly be known in the present Century, as in all Probability it may require some Ages of Observation to discover the Truth of it.

It remains that I should now give you some Idea of Time and Space; but this will afford Matter sufficient for another Letter.

I am, &c.



LETTER

LETTER THE EIGHTH.

Of Time and Space, with regard to the known Objects of Immensity and Duration.

S I R,

THE Opportunity you gave me in your last Visit, of shewing you my general Scheme of the Universe, I find, besides the Pleasure it then gave, is now attended with many useful Advantages.

I now not only hope to be better understood for the future, but have reason to expect what I now write will merit your Attention more, and have some Title to your Approbation. The Ideas I have fram'd of Time and Space, will now more gradually fill your Imagination both with Wonder and Delight, before they can arise so high as to be lost in an Eternity and the Infinity of Space. And I am fully perswaded your farther Inquiries into these vast Properties of the Deity, will here be answered intirely to your Satisfaction. You must allow me now to be in some measure a Judge of what I think will please you most, from the Observations you have made upon my general System, or otherwise you would have reason to think me perhaps too presuming: But I flatter myself the great Difficulty is now over; and what remains to be said, will also naturally follow from what has gone before, that this Letter, I guess, will go near to furnish you with all the Ideas you wish to form upon the Subject. To what you have said of my having left out my own Habitation in my Scheme of the Universe, having travell'd so far into Infinity as both to lose sight of, and forget the Earth, I think I may justly answer as *Aristotle* did when *Alexander*, looking over a Map of the World, enquir'd of him for the City of *Macedon*; 'tis said the Philosopher told the Prince, That the Place he sought for was much too small to be there taken Notice of, and was not without sufficient Reason omitted.

The System of the Sun compar'd but with a very minute Part of the visible Creation, takes up so small a Portion of the known Universe, that in a very finite View of the Immensity of Space, I judg'd the Seat of the Earth to be of very little Consequence, could I have possibly represented it, as not only being one of the smallest Objects in our Regions, but in a

manner infinitely less than even her own annual Orbit, and had nothing to do with my main Design, which was to represent all our planetary Worlds as one collective Body, and begin my comparative Scale of Magnitude from the Sun only and his Sphere of activity; as the smallest Object I could with any Propriety pretend to express in such a Plan.

In some Measure to convince you that I have committed no Error in this, I will try by some less mathematical Method than that of meer Numbers, to imprint an Idea in your Mind of the true Extent of the solar System, and the Magnitude of all its moving Bodies, by natural Objects most familiar to your Senses. When we endeavour to form any Idea of Distance, Magnitude, or Duration, by Numbers only, we so soon exceed the Limits of Conception, that this way we find our Faculties of reasoning as finite as our Senses; and no doubt 'tis right it should be so, Providence, as it were, having ordain'd that the first should only attend the last, in such an adequate Degree to a determin'd Distance; but what Distance or Degree of Knowledge is destin'd to human Nature, none but the Power that gave it can tell. 'Tis certain that beyond the third or fourth Place of our Nomenclator, we receive but very faint Impressions of the thing express'd, and can frame scarce any Notion at all of either Number, Distance, or Magnitude, signified beyond it: Hence Astronomers are frequently oblig'd to have recourse to mixt Ideas, and make Things of different Natures and Properties assist each other, to excite more adequate Ideas of what they would have conceived. Thus to express immense Distances and Magnitude, they frequently apply themselves to Time and Motion; and *vice versa*, to signify a long Duration, they have often recourse to Distance and Matter, removing, in Imagination, Worlds of Sand, Grain after Grain, to some remote known Region.

Hesiod, * to express his Idea of the Distance from his highest Heaven to Earth, and from Earth to Hell, or *Tartarus*, supposes an Anvil to be let fall from one to the other, which he says in nine natural Days would reach the Earth from Heaven, and in the same time would fall from the Earth to Hell. † *Homer* makes his *Vulcan* fall from Heaven to the Island of *Lemnos* in much less Time, not exceeding one full artificial Day.

* From the high Heaven a brazen Anvil cast,
Nine Nights and Days in rapid Whirls would last,
And reach the Earth the Tenth, whence strongly hur'd;
The same the Passage to th' infernal World.

COOKE.

† Hurl'd headlong downward from th' ethereal Height;
Toss'd all the Day in rapid Circles round,
Nor till the Sun descended touch'd the Ground.

POPE.
Modern

Modern Astronomers have made use of the swiftest Velocity of a Cannon-Ball as continued thro' the Space they would so describe, and in this Light, the Distance to the Sun has been by many compar'd to twenty-five Years Motion of a Cannon-Ball, supposing it to travel at the Rate of 100 Fathom in a Moment, *i. e. the Pulse of an Artery*; and that a Journey so performed to one of the nearest fix'd Stars, would take the same Body at least 100,000 Years before it could arrive there. But the Method I have chose to convey my Ideas of the Magnitude of the planetary Bodies, and the Extent of the visible Creation to you, I am willing to hope you will find still more familiar, comprehensive, and easy: And it only depends upon your Remembrance of a very few known Objects, and their neighbouring Distances, which may be presumed you are, or have been, very well acquainted with. You have not only very lately but very often been in *London*, and must, I think, retain some Idea of the Dome of *St. Paul's*, tho' I own I ought not to be sorry if you should chance to have forgot it, provided it might prove a Means of making your Visits more frequent. The Diameter of the Dome of this Church is 145 Feet: Now if you can imagine this to represent the Surface of the Sun, a spherical Body 18 Inches diameter, will justly represent the Earth in like Proportion; and another of only five Inches diameter, will represent the Moon. The Truths of these Proportions I have shewn in my *Clavis Cœlestis*; and the Reason why I have here fixt upon the Dome of this Church for my first Object of Comparison, will naturally appear from what follows.

From the Magnitude of the Earth on which we live, as from a known Scale with respect to its Parts compar'd with our own Bodies, we naturally frame our first Ideas of Extent, and fix our Rationale of Remoteness; by which we are sufficiently enabled to judge of all other sensible Distances within one finite View. And hence by the undoubted Principles of Geometry, having first given the Measurement of the Earth in any known Proportion with any other Quantity most familiar to our Senses, and the Angle of Appearance, or Parallax to any perceivable Object, we can easily find in homogenial Parts its true Distance from the Eye. And thus allowing for some small tho' unavoidable Errors, that may possibly arise from the Difficulties of Observation (especially small Angles and minute Quantities) we can always determine to a sufficient, and very frequently to a just Exactness, the relative Distance of all visible Bodies, remote or near, such as the Planets, Comets, and the Sun.

• In this Manner Astronomers having procur'd a comparative Standard, reduc'd to some known Measure, as *English* Miles, Leagues, Semi-Orbs or Orbits,

* Parallax is the changeable Position of Bodies to different Situations of the Eye. First having found the Quantity of a Degree (*i. e.* a 60th Part of the Circumference) upon the Earth's

Orbits, with all the Force of analogical Reasoning, clearly can demonstrate the Place and Distance of any Object within the Reach of Observation, and judge of Distances almost indefinite.

PLATE XXX.

Will help you to very correct Ideas of the real Magnitude of the Globe of the Earth, compar'd with the just Extent of the Island of *Great-Britain*, which you will find with *Ireland*, and the rest of its Islands, seated near the Center of the Projection. This as a Standard will enable you to judge of all other Distances more perfectly; and first I shall consider that of the Sun.

The Sun is found to be mean distant from the Earth nearly 81 Millions of Miles, or 6877,5 Diameters of the Earth; and *Saturn*, the remotest Planet from him is at his greatest Distance from us about 858 Millions of Miles: Yet these Distances are but the beginning of Space, and only serve to open our Ideas for farther Search.

The great Comet of 1680, as I have some where said before, was found to move in so vast an excentrick Orbit, that in its aphelion Point it would be 14,4 Times as far from the Sun, as the Orbit of *Saturn*, and hence at least eleven thousand and two hundred Millions of Miles from us. Now since the wise Creator hath so dispos'd all the independent Parts of the Creation, such as the several Systems of primary and secondary Planets, &c. at so great a Distance from each other, that the Laws of any one in no wise shall interfere, disturb, or interrupt the Principles of another; this Comet, which we can easily prove belong'd to our own Sun, we may well imagine came not near any other; and tho' at that vast Distance from the solar Body, yet still there must have remain'd a Space sufficient to divide or separate the sensible activity of neighbouring Systems, that they may not rush upon each other. Hence we may reasonably suppose, that the nearest Star can be no nearer than a triple Radius of its active Sphere; and provided they are all in regular Order, and much of the same Magnitude with one another (which no Arguments can possibly contradict) this Radius we may justly make 2000 times the Distance of our Earth. For admitting the utmost Limits of the Sun's Attraction to exceed this Sphere of the Comets, as far as the Sphere of the Comets

Earth's Surface, *Aratosthenes* discover'd that the Magnitude of the whole was easily known; and then from the Moon's horizontal Parallax having given the Radius of the Earth, the Distance of the Moon is soon determined; next by the mensural Parallax of the Lunar Orbit, the Distance of the Sun is found; and by the Elongation of the interior Planets, their mutual Distance from each other; and, lastly, from the annual Parallax of the Earth's Orbit, all the other Orbits of the superior Planets are easily found.

exceeds

THE
EARTH



1870-1



exceeds that of the Planets, which is nearly 14.4 times, the Radius of the solar System will be extended every way 200 Radius's of the Orbit of *Saturn*, and consequently the Distance from Star to Star will not be less than 6000 times the Radius of our *Orbis Magnus*, and consequently upwards of 480,000,000,000 Miles. That this is even less than the real Truth, and may be defended as a very moderate Computation, grounded upon Reason, we have infallible Demonstration to witness, and make appear as thus.

We know from the Nature of Distance and Motion that the Stars may have an annual Parallax, but it is so very small, that the very best Astronomers have never yet been able to assign what the Quantity really is. Yet it is allow'd by universal Consent, that it can't possibly be more than one Minute of a Degree, and may probably be much less. Mr. *Flamsteed*, by repeated Observations, made it in some of them upwards of 40"; but Mr. *Bradley* has endeavour'd to prove it is every where too small to be determined, and assigns this Angle to another Cause. This way then we cannot make their Distance less; and to prove that it is something more than I have said it is, let us even increase the doubtful Parallax of 40" to the most it possibly can be, viz. to 60" or 1'; and by the Solution of the Triangle, we shall find that the nearest Star is 6875 times the Radius of the Earth's Orbit from the Sun: And this tho' more than any other Proportion makes them, is still undeniably less than the Truth, which every Mathematician will of course be convinc'd of; and you yourself of force must believe, when you are told, that the smaller the Angle of Parallax is, the farther the Body is remov'd from us. By which Rule, according to Mr. *Flamsteed*'s Observations, the Distance must be still greater: By the optical Experiment of * Mr. *Huygens*, greater still than this; and according to Mr. *Bradley*, so much more as not even too be determin'd.

Now if the rest are in general from each other, allowing the same Extent of System, and as much to part the like Extrems of active Virtue, be in such Proportion of aerial Space, it will appear, that to pass from any one Star to another, we must fly thro' so vast a Tract of pure Expanse or Ether, that to visit any one of the most neighbouring Systems, could we travel even as fast as the swiftest Eagle flies, for Instance, 500 Miles per Day, yet should we be 3,000,000 of Years upon our way before we could arrive there; and if continuing on to view the Regions of the rest within the known Creation, Myriads of Ages would be spent, and yet we could not hope to see the whole of but the smallest Constellation.

* 27664 Radius's of the *Orbis Magnus*, equal to the Distance of *Syrius*, whose Parallax should be to answer it but 14" 48".

But

But what Idea of Distance can you receive from this sort of Estimation, where Numbers arise so very high. I own to you mine are soon quite lost by this Method of counting, either, Distances or Duration. I believe few People can range their Ideas with such Perspicuity, as to arrive at any adequate Notion of any Number above a thousand.

To give you therefore a clearer Idea of Distance, and impress the Proportions of Space more strongly and fully in your Mind, let us suppose the Body of the Sun, as I have said before, to be represented by the Dome of *St. Paul's*; in such Proportion a spherical Body eighteen Inches Diameter, moving at *Mary-le-bone*, will justly represent the Earth, and another of five Inches Diameter, describing a Circle of forty-five Feet and a half Radius round it, will represent the Orbit and Globe of the Moon. A Body at the *Tower* of 9,7 Inches, will represent *Mercury*; and one of 17,9 Inches at *St. James's Palace* will represent the Planet *Venus*; *Mars* may be supposed at a Distance, like that of *Kensington* or *Greenwich*, 10 Inches Diameter: *Jupiter*, imagined to be at *Hampton-Court*, or *Dartford* in *Kent*; and *Saturn*, at *Chiefden*, or near *Chelmsford*: The first represented by a Globe 15 Foot 4 Inches Diameter, the latter by one of 11 Feet; and his Ring four Feet broad: These would all naturally represent the planetary Bodies of our System in their proper Orbits and proportional Magnitudes, as moving round the Cupola of *St. Paul's*, as their common Center the Sun. And preserving the same natural Scale, the Aphelion of the first Comet would be about *Bury*, the second at *Bristol*, and the third near the City of *Edinburgh*. But if you will take into your Idea one of the nearest Stars; instead of the Dome of *St. Paul's*, you must suppose the Sun to be represented by the gilt Ball upon the Top of it, and then will another such upon the Top of *St. Peter's* at *Rome* represent one of the nearest Stars.

The whole System exhibited in the above Proportion, would be nearly as follows:

Diameter of the Sun	145 Feet.
<i>Saturn</i>	11,587, his Ring 27,54, its Breadth 4.
<i>Jupiter</i> ,	15,39.
<i>Mars</i> ,	10,15 Inches.
the Earth,	18,125.
<i>Venus</i> ,	17,98
<i>Mercury</i> ,	9,715
and the Moon,	4,93

Distance

- * Distance of *Saturn* from the Sun, 27 Miles, and 1700 Yards.
Jupiter, 15 Miles, and 458 Yards.
Mars, 4 Miles, and 751 Yards.
the Earth, 2 Miles, and 1632 Yards.
Venus, 2 Miles, and 217 Yards.
Mercury, 1 Mile, and 267 Yards.

and of the Moon, from us, 45 Yards and a half.

That of the most distant Comet 390, and the nearest of the Stars not less than 6875, † Radius's of the *Orbis Magnus*.

Now, if like Creations crowd the vast Depths of Infinity, and if each are adapted to receive Beings of different Natures, where must our Wonder and Ideas have end ?

As it is evident in the Sign *Taurus*, in *Perseus*, and *Orion*, that we can plainly perceive Stars to the sixth and ninth Magnitude, the former with our naked Eye, the other by the Help of Telescopes, the vifional ocular Creation cannot be less than 4,320,000,000,000 Miles in semi Diameter, and admitting a regular Distribution of those primordial Bodies amongst themselves, the Depth, or most remote Limits of the *Vortex Magnus* from Side to Side, cannot be less than 8 m, m, 640 thousand of Million of Miles, admitting it is no more than what we see; and lastly, supposing our System to be situated nearly in the Middle of the *Vortex Magnus* (which, from the visible Order of the Stars, we may justly conjecture, with the highest Probability of Truth) the nearest Distance of the *Ens Primum*, in the Realms of eternal Day, will rise to 30,000,000,000,000 Miles, but more probably to 100,000,000,000,000 Miles, making the Confines of Creation from Verge to Verge in the first Case, upwards of 68 Million of Millions of Miles, Diameter, and by the last above 200'. But, if we compute the Distance of the Stars after the Manner of *Huygens*, for his Distance of *Syrius* from the Sun, the Distance of the Region of Immortality without exceeding Probability may rise to near 1,000,000,000,000,000 Miles.

Now to pass by any progressive Motion from the outward Verge, or Borders of the Creation, thro' the starry Regions of Mortality, if I may call

* Of the Satellites of <i>Saturn</i> in the above Proportion.					And those of <i>Jupiter</i> .				
The	1	be	27,96	} Feet distant from his Center.	The	1	be	28,51	} Feet distant from him.
	2		35,52			2		69,177	
	3	would	50,			3	would	110,224	
	4		114,			4		190,	
	5		341,9						

* Radius, or Sign of	89	59	30	—	—	10,0000000
Sine subtract of	0	0	30	—	—	6,1626961

Hence the Distance 6875,5 — — — — — 3,8373039

L

them

them so, as far as the Center of the *Ens Primum*, or *Sedes Beatorum*, according to *Homer*, or *Milton's* Manner of measuring Space, a Body falling, or a Being moving with a Velocity but of 1000 Feet *per Minute*, *i. e.* at the Rate of 20,000 Yards *per Hour*, or about 300 Miles *per Day*, would be at least 300,000,000 Years upon its Journey thither, if not 1,000, m, and perhaps much more, without offending Probability; but even three Million Centuries, or Ages, sure is enough to be employ'd, in passing from one Place to another; therefore, we may conclude, the Soul must have some other Vehicle than can be found in the Ideas of Matter to convey it so far, at least at once. Hence we may truly infer, that the Soul must be immaterial, and that in all Probability there may be States in the Universe so much more longer lived than ours, that, compared with the Age of Man, the Age of such Beings may be almost as an Eternity, or rather, as that of the human Species to that of a Sun-born Insect.

Again, if there are still Stars beyond all these of other Denomination, which we do not here perceive, how vastly must these Numbers be increased, to express, almost without Idea, the amazing Whole of this one visible Creation; but what has been already said, I judge will be sufficient to show the Immensity of Space, and help you to conceive the stupendous Nature of an endless Universe; every where the home Possession, Production, and instantaneous Care, of an infinite good Being, perfectly wise, and powerful, of whom we can have no Idea more, than a Being in dark Privation can have of Light, but through the Lustre of his own resplendent Attributes.

Thus, having attempted to enlarge your Ideas of the Creation in general, and in some measure having considered the Indefinity of Space, I shall in the next Place proceed to give you some Account of my Notions of Time.

As Distance is the Measure of Magnitude and of all Extent, and helps our Imagination to the Ideas of Space, so are progressive Moments the Measure of Velocity, and makes us sensible of Duration: And as Space may be extended through all Infinity, so Time may be continued as to Eternity. This Succession of temporal Ideas impressed, or excited in the Mind, as an Effect of Matter in Motion, producing a perpetual Change, both of Objects earthly and celestial, enables us not only to reflect upon past Vicissitudes of Nature, but from their regular Courses, known Order and Returns, predict Phænomena to come, and prove the periodical Effects of Nature's constant Laws so just and certain, that Time may be said with Truth, to co-exist with Motion.

Measure being a certain Quantity of Sensation interwove with our Ideas of Distance and Duration, proceeding from a Reflection of what is impressed upon the Mind by some external Object, I must again return to our Mother of Ideas the Earth, and from thence, as I did, of Distance, frame

frame the original Images best suited to the Understanding, proper for our Judgment of Duration.

Time takes its first Denomination from the diurnal Rotation of the Earth upon its Axis, which we call a natural Day, and this for obvious Reasons we subdivide in twenty-four Parts or Hours. This diurnal Motion having been successively repeated, and the Day renewed three hundred and sixty-five Times, we find that all the vegetable World has gone through all its Variegations, and Nature has again put on the same Face, adapted to the Season; during which Time, and indeed which occasions this general Change and Repetition, the Earth is found to make one intire Revolution round the Sun. This Space, or Period of Time, we call a solar, or rather a natural Year; and from our Sensibility of this, and its constituent Parts, both horary and diurnal, we form our general Judgment of Duration.

Saturn, the most remote, and most regular Planet in our System, as has been said before, performs one Revolution round the Sun in about twenty-nine of the above solar Years: The great Comet of 1680 makes but one periodical Return in five hundred and seventy-five of those Years, and the general Motion of the Stars, arising from the Procession of the Equinoxes, altogether continually changing their Aspect, or Position, at the Rate of 50" *per* Year round the ecliptic Poles, compleats but one Revolution in 25920 Years; in which Time the whole sidereal Frame of Heaven has changed, and every Star returned to the same Point of the solar Sphere it set out from. This is by many called the great *Saturnian* Year: Concerning which, Mr. *Addison* has thus translated an eminent Author.

When round the great *Saturnian* Year has turn'd,
In their old Ranks the wandering Stars shall stand,
As when first marshall'd by the Almighty's Hand.

ADDISON.

Now, if this sidereal Revolution, arising from a secondary Cause, require this Number of Years to perfect one Rotation, what must their primitive Orbits take to circumscribe the *Vortex Magnus*.

It has been observed, that the biggest Star to us scarce moves a Minute in an hundred Years, and the most remote as insensibly for Ages, from whence and what has been already said of the imagined Distance of the general Center, we may frame this probable and well-grounded Guess, that the mean Revolution of a Star near the Middle of the *Vortex Magnus*, cannot be made in less than a Million of Years, and though to us imperceptible, our Sun in his own orbicular Direction, may be moving many Miles *per* Day. Besides, if local Motion can be proved amongst the Stars, what less than an Eternity can again restore them to their original Order and primitive State.

Such vast Room in Nature, as *Milton* finely expresses it, cannot be without its Use; and nothing but absolute Demonstration is wanting (which from their Nature and Distance cannot be expected) to confirm the grand Design, so suited to the Deity's infinite Capacity, and of eternal Benefit to all his Creatures, especially Beings of a rational Sense, and in particular Mankind.

Of these habitable Worlds, such as the Earth, all which we may suppose to be also of a terrestrial or terraqueous Nature, and filled with Beings of the human Species, subject to Mortality, it may not be amiss in this Place to compute how many may be conceived within our finite View every clear Star-light Night. It has already been made appear, that there cannot possibly be less than 10,000,000 Suns, or Stars, within the Radius of the visible Creation; and admitting them all to have each but an equal Number of primary Planets moving round them, it follows that there must be within the whole celestial Area 60,000,000 planetary Worlds like ours. And if to these we add those of the secondary Class, such as the Moon, which we may naturally suppose to attend particular primary ones, and every System more or less of them as well as here; such Satellites may amount in the Whole perhaps to 100,000,000, or more; in all together then we may safely reckon 170,000,000, and yet be much within Compass, exclusive of the Comets which I judge to be by far the most numerous Part of the Creation.

In this great Celestial Creation, the Catastrophy of a World, such as ours, or even the total Dissolution of a System of Worlds, may possibly be no more to the great Author of Nature, than the most common Accident in Life with us, and in all Probability such final and general Doom-Days may be as frequent there, as even Birth-Days, or Mortality with us upon the Earth.

This Idea has something so chearful in it, that I own I can never look upon the Stars without wondering why the whole World does not become Astronomers; and that Men endowed with Sense and Reason, should neglect a Science they are naturally so much interested in, and so capable of enlarging the Understanding, as next to a Demonstration, must convince them of their Immortality, and reconcile them to all those little Difficulties incident to human Nature, without the least Anxiety.

Such a Prothesis can scarce be called less than an ocular Revelation, not only shewing us how reasonable it is to expect a future Life, but as it were, pointing out to us the Business of an Eternity, and what we may with the greatest Confidence expect from the eternal Providence, dignifying our Natures with something analogous to the Knowledge we attribute to Angels; from whence we ought to despise all the Vicissitudes of adverse Fortune, which make so many narrow-minded Mortals miserable.

I am now, &c.

LETTER THE NINTH.

Reflections, by Way of General Scolia, of Consequences relating to the Immortality of the Soul, and concerning Infinity and Eternity.

S I R,

THIS my last Letter to you, I mean my final astronomical one, I propose as a *General Scolia* to the rest, the principle Matter being Reflections upon what is gone before, with some Conclusion naturally following or appendant to what has been already said; but which, I could not in any other Place, so properly remark to you.

The Probability of the foregoing Conjectures, chiefly built upon very distant Observations, shew an apparent Necessity for some other kind of Doctrine permitted by Providence, to give Mankind a Knowledge of their Immortality and Dependance upon it, in the first Ages of the World.

And for the same Reason it evidently appears, that the ancient Philosophers had it not in their Power to prove a supream *Being* and Director of all Things this Way.

And yet, as by a Sort of Instinct, or natural Reason, and Consciousness of a good Principle, we see how many noble Steps they made towards it, and was convinc'd at last of this *great Truth*, that since there was a *Mind* in so imperfect a Creature as Man, the *perfect Universe*, which comprehended all Things, could not possibly be without one; and as Sir *Isaac Newton* has justly observed in his *Principia*, "If every Particle of Space be *always*, and every individual Moment of Duration *every where*; surely the Maker and Lord of all Things, cannot be *never* and *no where*."

To make manifest the infinite Empire and Agency of God, from celestial Motion, became the Task, but of very late Years; and I can't help being of Opinion, that by means of these primary Bodies, only, we shall at length be able to trace the greater Circulations, and Laws of Nature, to their real original and fountain Head.

These

These, were any thing wanting, besides the *Miracle ourselves*, to convince us of a divine Origination, are all infallible Proofs, that the Universe is governed by an intelligent and all-powerful Being, whose Existence is too nearly related to a self-evident Truth to be more clearly demonstrated, than it is manifest of itself, both from the particular Laws of Nature, and the general Order of Things. An Argument which has been thought of no small Force, and well worth observing in the Infancy of *Christianity*. *The invisible Things of God are clearly seen, being understood by the Things that are made, even his eternal Power and Godhead.* Rom. i. 20.

But 'tis now high time to look back upon my Theory, and tell you it is a vain Supposition, to imagine I shall ever be able to convince every Reader, either of the Truth or Probability of what I have advanced to you : Mathematical Assistance not being to be expected, where perhaps it has never been thought of ; and I allow you, it is much more reasonable to expect, that fifty Persons will read these Letters without perceiving the Reasonableness of them, than that five should consider them with proper Judgment.

I must ingenuously confess to you, that nothing is wanting to convince me intirely of the Certainty of what I here advance by way of Conjecture to you. But this you must only look upon as an happy Partiality, which generally attends all Authors, and always will be the chief Support of their tedious Labours. I assure you, I have neither Hopes nor Expectation, no, not the weak Breath of a Wish, to be admitted a proper Judge of my own Works. But I shall always take their Imperfection to be rather, (like my own Faults) to be too near me to be seen ; I therefore trust all to my Friend, and if I am so fortunate as to excite his Approbation, I shall think myself very happy in a very favourite Point ; which is, The advancing nothing which a rational Reader would willingly overlook, or be ignorant of.

But if I have been so happy as to come so near the Mark, as to border upon Truth, I believe you will allow me to carry my Conjectures a little further, and point out some farther pleasing Consequences, which I begin to perceive may naturally follow.

Should it be granted, that the Creation may be circular or orbicular, I would next suppose, in the general Center of the whole an intelligent Principle, from whence proceeds that mystick and paternal Power, productive of all Life, Light, and the Infinity of Things.

Here the to-all extending Eye of Providence, within the Sphere of its Activity, and as omnipresently presiding, seated in the Center of Infinity, I would imagine views all the Objects of his Power at once, and every Thing immediately direct, dispensing instantaneously its enlivening Influence,
to

to the remotest Regions every where all round. I know you'll say Astronomers are never to be satisfied, and I must own where there is so much rational Entertainment for the human Mind, and so suitable to the true Dignity of God, and most worthy of Man, it is not easy to know where to stop in such a Scene of Wonders.

Having, I say, once granted that all the Stars may move round one common Center, I think it is very natural to one, who loves to pursue Nature as far as we may, to enquire what most likely may be in that Center; for since we must allow it to be far superior to any other Point of Situation in the known Universe, it is highly probable, there may be some one Body of sidereal or earthy Substance seated there, where the divine Presence, or some corporeal Agent, full of all Virtues and Perfections, more immediately presides over his own Creation. And here this primary Agent of the omnipotent and eternal Being, may sit enthroned, as in the *Primum Mobile* of Nature, acting in Concert with the eternal Will. To this common Center of Gravitation, which may be supposed to attract all Vertues, and repel all Vice, all Beings as to Perfection may tend; and from hence all Bodies first derive their Spring of Action, and are directed in their various Motions.

Thus in the *Focus*, or Center of Creation, I would willingly introduce a primitive Fountain, perpetually overflowing with divine Grace, from whence all the Laws of Nature have their Origin, and this I think would reduce the whole Universe into regular Order and just Harmony, and at the same time, enlarge our Ideas of the divine Indulgence, open our Prospect into Nature's fair Vineyard, the vast Field of all our future Inheritance.

But what this central Body really is, I shall not here presume to say, yet I can't help observing it must of Necessity, if the Creation is real and not merely Ideal, be either a Globe of Fire superior to the Sun, or otherwise a vast terraqueous or terrestrial Sphere, surrounded with an Æther like our Earth, but more refined, transparent and serene. Which of these is most probable, I shall leave undetermined, and must acknowledge at the same time, my Notions here are so imperfect, I hardly dare conjecture. 'Tis true, I have ventur'd to think it may be one of these, and since so glorious a Situation can hardly be supposed without its proper Inhabitants, 'tis most natural to conclude it may be the latter. In the first Case, besides our having no Idea of Beings existing in Fire, it would not, notwithstanding its Distance, be so easy to account for its being invisible; and since the Lustre of the Stars are all innate, they could receive no Benefit from it, and consequently such a Nature as a solar Composition, must in this Place be render'd useless; but in the latter Sup-
position:

position of its being a dark Body, we have no Difficulty attending us, having several Instances of like Bodies, moving round an opaque one. Now when we consider, that all those radiant Globes, which adorn the Skies, those bright ætherial Sparks of elemental Fire, thick strewed like Seeds of Light all round our Hemisphere, are each to us the Embrio of a glorious Sun ; how awful and stupendious must that Region be, where all their Beams unite and make one inconceivable eternal Day ?

Though the Deity, says a learned Writer “ be essentially present thro’ all the Immensity of Space, there is one Part of it in which he discovers himself in a most transcendent and visible Glory. This is that Place which is mark’d out in Scripture, under the different Appellations of PARADICE ; *the third Heaven ; the Throne of God, and the Habitation of his Glory.*”

THIS continues the same Author, is “ that Presence of God, which some of the Divines call his glorious, and others his majestick Presence.”

It is here, and here only, as in the Center of his infinite Creations, where he resides in a sensible Magnificence, and in the midst of those Splendors, which can Effect the Imagination of his Creatures ; and though the most sacred and supreme Divinity be allowed as essentially present in all other Places as well as in this, as being a BEING whose Center is every where, and Circumference no where ; yet it is here only, or in such Sensorium of his Unity, where he manifests his corporeal Agency, as in the Foci of his infinite Empire over all created Beings. It is to this majestick Presence of God, we may apply those beautiful Expressions of Scripture, “ *Behold even to the Moon and it shineth not ; yea the Stars are not pure in his Sight.*”

“ The Light of the Sun, and all the Glories of the World, on which we live, are but as weak and sickly Glimmerings, or rather Darkeness it self, in Comparison of those Splendors, which encompass this Throne of God.”

Here Heav’ns wide Realms an endless Scene displays,
And Floods of Glory thro’ its Portals blaze ;
The Sun himself lost in superior Light,
No more renews the Day, or drives away the Night :
The Moon, the Stars, and Planets disappear,
And Nature fix’t makes one eternal Year.

Here and here alone center’d in the Realms of inexpressible Glory, we justly may imagine that primogenial Globe or Sphere of all Perfections,
subject

subject to the Extrems of neither Cold nor Heat, of eternal Temperance and Duration. Here we may not irrationally suppose the Vertues of the meritorious are at last rewarded and received into the full Possession of every Happiness, and to perfect Joy. The final and immortal State ordain'd for such human Beings, as have pass'd this Vortex of Probation thro' all the Degrees of human Nature with the supream Applause.

What vast room is here, for infinite Power and Wiidom to act in, and that so visibly takes Delight to bless all his Beings with his Bounty. And endless as his Prescience, Attributes, and Goodness, are undoubtedly all those natural and apparent Joys with which he manifests his Love to all his Creatures, a Multiplicity of Objects not to be enumerated. For where-soever we turn our Eyes, and follow with our Reason, we may meet with Worlds of all Formations, suited no doubt to all Natures, Tastes, and Tempers, and every Class of Beings.

Here a Groupe of Worlds, all Vallies, Lakes, and Rivers, adorn'd with Mountains, Woods, and Lawns, Cascades and natural Fountains; there Worlds all fertile Islands, cover'd with Woods, perhaps upon a common Sea, and fill'd with Grottoes and romantick Caves. This Way, Worlds all Earth, with vast extensive Lawns and Vistoes, bounded with perpetual Greens, and interspersed with Groves and Wildernesses, full of all Varieties of Fruits and Flowers. That World subsisting perhaps by soft Rains, this by daily Dews, and Vapours; and a third by a central, subtle Moisture, arising like an Effluvia, through the Pores and Veins of the Earth, and exhaling or absorbing as the Season varies to answer Nature's Calls. Round some perhaps, so dense an Atmosphere, that the Inhabitants may fly from Place to Place, or be drawn through the Air in winged Chariots, and even sleep upon the Waves with Safety; round others possibly, so thin a fluid, that the Arts of Navigation may be totally unknown to it, and look'd upon as impracticable and absurd, as Chariot flying may be here with us; and some where not improbably, superior Beings to the human, may reside, and Man may be of a very inferior Class; the second, third, or fourth perhaps, and scarce allow'd to be a rational Creature. Worlds, with various Moons we know of already; Worlds, with Stars and Comets only, we equally can prove is very probable; and that there may be Worlds with various Suns, is not impossible. And hence it is obvious, that there may not be a Scene of Joy, which Poetry can paint, or Religion promise; but somewhere in the Universe it is prepared for the meritorious Part of Mankind. Thus all Infinity is full of States of Bliss; Angelic Choirs, Regions of Heroes, and Realms of Demi-Gods; Elysian Fields, Pindaric Shades, and Myriads of enchanting Mansions,

M

not

not to be conceived either by Philosophy or Fancy, assisted by the strongest Genius and warmest Imagination.

All harmoniously crowded and provided with every Object of Beauty, that Friendship, Love, or Society can inspire, the Muses or the Graces Frame; and all as permanent and perfect, that is destin'd to a Duration, suited to the Nature of their Existence and Degree of Cognisance; for as a very learned Writer observes upon this same Subject;

“How can we tell, but that there may be above us Beings of greater Powers, and more perfect Intellects, and capable of mighty Things, which yet may have corporeal Vehicles as we have, but *finer* and *invisible*? Nay, who knows, but that there may be even of these many Orders, rising in Dignity of Nature, and Amplitude of Power, one above another? It is no Way below the Philosophy of these Times, which seems to delight in enlarging the Capacities of Matter, to assert the Possibility of this.”

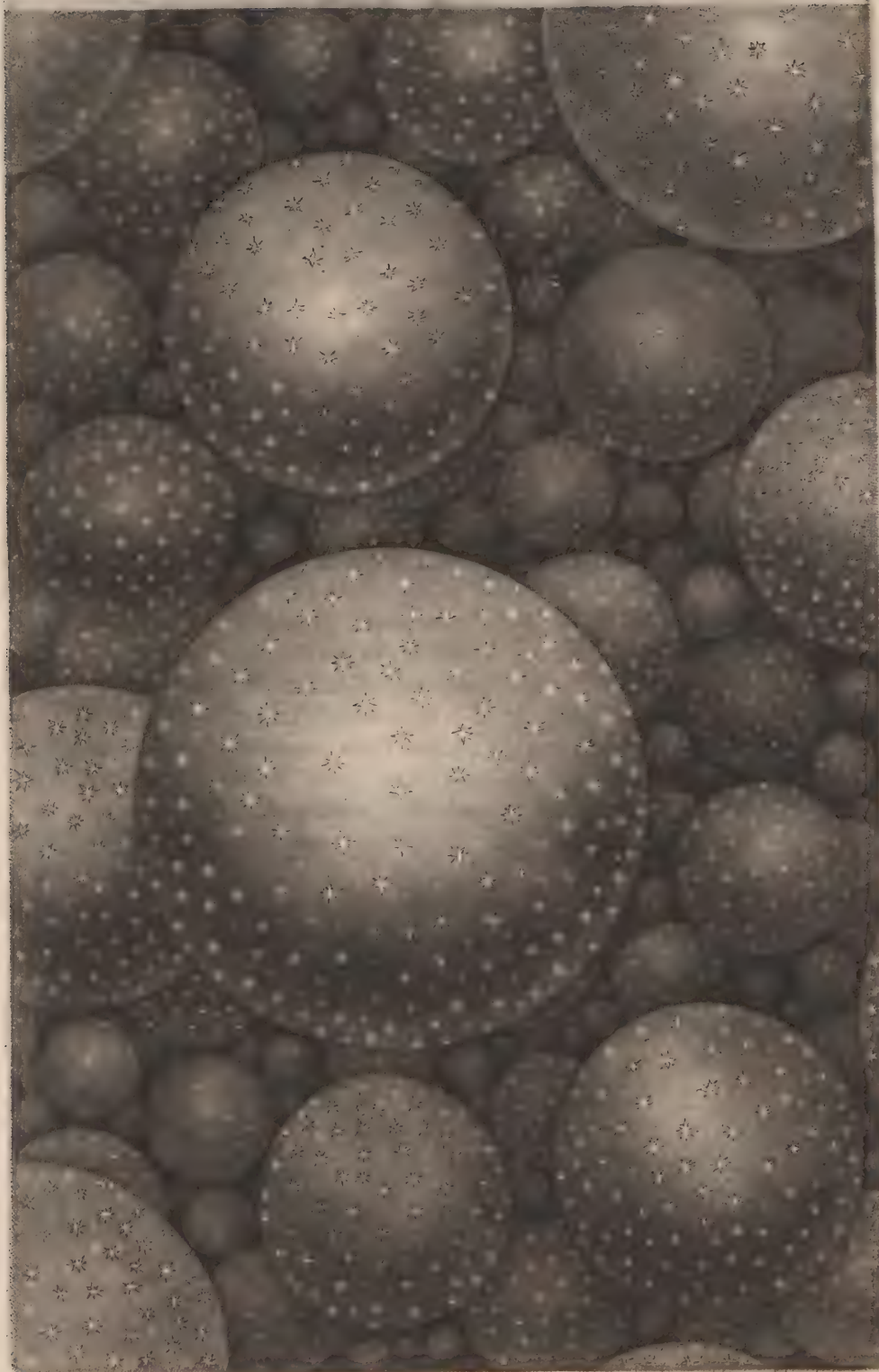
From these amazing Ideas of Space in general, and from the particular Distance of the Stars, which separates as it were, one System of Bodies from another, and by so prodigious an extent, as scarce to be suppos'd a temporal Task. I think it naturally follows, had we no other Way to prove it, or any other Reason to believe it, that the Soul must of Necessity be immaterial; for as this Space seems so impassible to Matter, as not to be undertaken and performed without the Loss of Ages, in a State only of Transmigration, we may well imagine, that Change of Place is not effected this Way, but by some other Vertue or Property, more immediate, if not instantaneous.

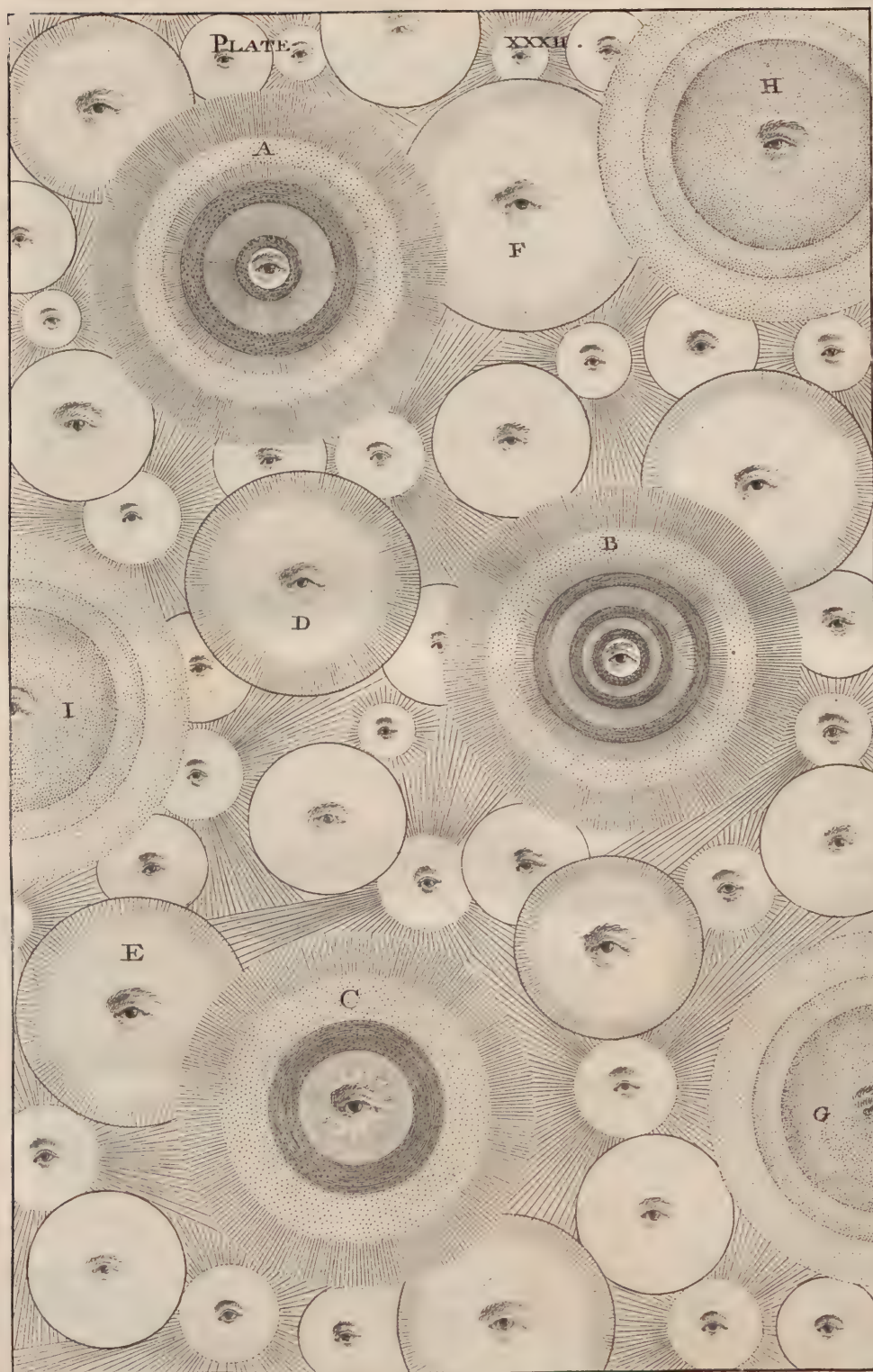
I own next to *Annihilation* is the State of Oblivion, and this Way we may solve all Difficulties with regard to our being sensible of such a Loss of Existence; but if we allow the Soul to be immaterial, it no longer has any thing to do with Space, but as operating by Reflection only, or the Faculty of Thinking; it may be like the Imagination where it pleases in a Moment.

Objects of the Mind abstracted from the Senses of the Body, has no real or comparative Magnitude; that is, I would say, an Inch, a Foot, a Yard, a Mile, or a Million of Miles are all equally indefinite, and is thus prov'd; every finite Line is formed of an infinite Number of Points, and no finite Line can be solv'd into more. Thus if you will allow me the Expression, the Mind being magnified as all Objects are diminished, what seems impracticable in the natural State of Things, in an Ideal one, becomes very possible; that is, to make myself more intelligible, though we can hardly conceive, how any Being can pass from *Syrius* to the Sun, by natural Laws in their proper State, yet if proportionally reduced by a
new



PLATE. XXXI.





new Modification of Ideas, to the Bigness of a Ball 6 Feet Diameter, and to be only 680 Miles asunder; the Thing is very comprehensive and easy.

Hence Vision, Light, and Electrical Virtue, seem to be propagated with such Velocity, that nothing but God can possibly be the Vehicle; and hence we may justly say with St. Paul, *Acts xvii. 28. In him we live, in him we move, in him we have our Being.*

It will further appear, from the foregoing Letters, that all the Stars and planetary Bodies within the finite View, are altogether but a very minute Part of the whole rational Creation; I mean that vast collective Body of habitable Beings, which I have endeavoured to demonstrate, are all govern'd by the same Laws, though variously revolving round one common Center, in which Center we may not impertinently venture to suppose the prime Agent of our Natures; or otherwise, the most perfect of all created Beings, illimitable in his Ideas and Faculties of Sensation particularly preside.

But tho' past all diffus'd, without a Shore
His Effence; *local* is his Throne, (as meet)
To gather the dispers'd, (as Standards call
The list'd from afar) to fix a Point;
A central Point, collective of his Suns,
Since finite ev'ry Nature, but his own. *Dr. Young.*

And farther since without any Impiety; since as the Creation is, so is the Creator also magnified, we may conclude in Consequence of an Infinity, and an infinite all-active Power; that as the visible Creation is supposed to be full of sidereal Systems and planetary Worlds, so on, in like similar Manner, the endless Immensity is an unlimited Plenum of Creations not unlike the known Universe. See *Plate XXXI.* which you may if you please, call a partial View of Immensity, or without much Impropriety perhaps, a finite View of Infinity, and all these together, probably diversified; as at A, B and C. in *Plate XXXII.* which represents their Sections, if all may be a proper Term for an infinite or indefinite Number, we may justly imagine to be the Object of that incomprehensible Being, which alone and in himself comprehends and constitutes supreme Perfection.

That this in all Probability may be the real Case, is in some Degree made evident by the many cloudy Spots, just perceivable by us, as far without our starry Regions, in which tho' visibly luminous Spaces, no one Star or particular constituent Body can possibly be distinguished; those in
all

all likelihood may be external Creation, bordering upon the known one, too remote for even our Telescopes to reach.

With the raptur'd Poet may we not justly say

O, what a Root! O what a Branch is here!
O what a Father! what a Family!
Worlds! Systems! and Creations!

And in Consequence of this

In an Eternity, what Scenes shall strike?
Adventures thicken? Novelties surprize?
What Webs of Wonder shall unravel there?

Night Thoughts.

So many varied Seats where every Element may have its proper Beings and all adapted to partake of every thing suited to their Natures, argue such Maturity of Wisdom, and the vast Production such mysterious Power; 'tis hardly possible for Mortals not to see divine Intelligence preside, and that every Being somewhere must be happy.

A Universe so well designed, and fill'd with such an endless Structure of material Beings, and all the Result of Prescience and infinite reflected Reason, flowing from a Mind all perfect, full of all Ideas, could never be designed in vain; and tho' our narrow Bounds of Reason limited, by finite Senses, cannot directly see the Consequence dependant on a Sequel, yet from what we do see, great Room we have to hope the next Stage of Existence will be more lasting and more perfect; and it is highly probable, the noblest Suggestion of the most luxuriant Fancy may fall infinitely short of what we are designed for.

But here, even in this World, are Joys which our Ideas of Heaven can scarce exceed, and if Imperfection appear thus lovely, what must Perfection be, and what may we not expect and hope for, by a meritorious Acquiescence in Providence, under the Direction, Indulgence, and Protection of infinite Wisdom and Goodness, who manifestly designs perfect Felicity, as the Reward of Virtue in all his Creatures, and will at proper Periods answer all our Wishes in some predestined World.

All this the vast apparent Provision in the starry Mansions, seem to promise: What ought we then not to do, to preserve our natural Birthright to it and to merit such Inheritance, which alas we think created all to gratify alone, a Race of vain-glorious gigantick Beings, while they are confined to this World, chained like so many Atoms to a Grain of Sand.

I am, &c.

A

L I S T

O F T H E

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THE CONTENTS.

LETTER THE FIRST.

Concerning the Opinions of the most eminent Authors whose Sentiments upon this Subject have been published in their Works. Page 1

LETTER THE SECOND.

Concerning the Nature of Mathematical Certainty, and the various Degrees of Moral Probability proper for Conjecture. 9

LETTER THE THIRD.

Concerning the Nature, Magnitude, and Motion of the Planetary Bodies round the Sun. 18

LETTER THE FOURTH.

Of the Nature of the heavenly Bodies continued, with the Opinions of the Antients concerning the Sun and Stars. 27

LETTER THE FIFTH.

Of the Order, Distance, and Multiplicity of the Stars, the Via Lactea, and Extent of the visible Creation. 37

LETTER THE SIXTH.

Of General Motion amongst the Stars, the Plurality of Systems, and Innumerable Worlds. 48

LETTER THE SEVENTH.

The Hypothesis, or Theory, fully explained and demonstrated, proving the sideral Creation to be finite. 58

LETTER THE EIGHTH.

Of Time and Space, with regard to the known Objects of Immensity and Duration. 67

LETTER THE NINTH.

Reflections, by way of General Scolia, of Consequences relating to the Immortality of the Soul, and concerning Infinity and Eternity. 77

DIRECTIONS for placing the P L A T E S.

<i>Plate.</i>	<i>Page.</i>	<i>Plate.</i>	<i>Page.</i>	<i>Plate.</i>	<i>Page.</i>	<i>Plate.</i>	<i>Page.</i>
I.	10	IX.	22	XVII.	51	XXV.	64
II.	11	X.	23	XVIII.	52	XXVI.	<i>ibid.</i>
III.	16	XI.	35	XIX.	56	XXVII.	64
IV.	20	XII.	38	XX.	<i>ibid.</i>	XXVIII.	65
V.	<i>ibid.</i>	XIII.	<i>ibid.</i>	XXI.	62	XXIX.	<i>ibid.</i>
VI.	22	XIV.	40	XXII.	63	XXX.	70
VII.	<i>ibid.</i>	XV.	42	XXIII.	64	XXXI.	83
VIII.	<i>ibid.</i>	XVI.	<i>ibid.</i>	XXIV.	<i>ibid.</i>	XXXII.	<i>ibid.</i>

Some of the Principal E R R A T A.

<i>Page</i>	<i>Line</i>	<i>the Words</i>	<i>Read.</i>
2	ult.	to cease relating	ceasing to relate
4	3	Phænomenon	Phænomena
16	15	incomfible	incomprehensible
21	12	comprehend	comprehending
33	28	compared	is compared
34	37	form	from
43	20	volving	revolving
49	24	immoveable	moveable
61	19	much	much as
62	28	XXIII.	XXI.
65	4	where	any where
67	15	also	all so
69	29	one	our

Plate X. read the Characters of the Planets in this Order ♃ ♄ ♅ ♆ ♇ ♈

T H E





